PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-177 TIMES BUILDING, NEW YORK.

Established 1874. Incorporated 1889.

W. J. JOHNSTON, Prest. C. E. STUMP, Treas. and Bus. M'g'r.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

T. COMMERFORD MARTIN and JOS. WETZLER, M. E., Editors.
WM. A. ROSENBAUM, Editor Patent Department.
WALTER T. HUNT, Advertising Department.

New England Office, 8 Cook Building, Boston.
Western Office, 39 Mallers Building, Chicago.
Philadelphia Office, 31 City Trust Building.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.

(Including Postage in the U. S., Canada or Mexico.)

IN CLUBS of four or more, $2.50 a year each; with a free extra copy to the getter up of a club of 8. Foreign subscription, $5 a year.

In requesting your address changed, give **old** *as well as new address.*

ESTABLISHED 16 YEARS AGO, **THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the LARGEST CIRCULATION of any electrical periodical in the world, and is the BEST ADVERTISING MEDIUM.**

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.
For Sale Notices, Situations or Help Wanted, $1 to $2 an issue.
Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.
Matter for the **Editorial** Department should be addressed to
The Editors of The Electrical World, New York.
Subscriptions and communications relating to **advertising** or the **business department** should be addressed to
THE W. J. JOHNSTON COMPANY, Ltd.,
Times Building, New York
OR ANY OF THE BRANCH OFFICES.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE
Ferranti Alternating Machines at the Paris Exposition ... 48
Delany's Improved Gravity Battery ... 49
The Thomson-Houston Exhibit at the Paris Exposition ... 49
Trans-Atlantic Cable Routes ... 50
The New Anglo-American Storage Battery ... 50
The Annapolis, Md., Central Station ... 51
Thermo-Electricity Theoretically and Practically Considered.—I ... 52
The New Wood Dynamo and Regulator ... 54
Chapman and Dearing Arc Lamp ... 55
More Alternating Current Litigation ... 55
Sprague Electric Railway at Atlantic City, N. J ... 55
Studying Alternating Currents by Means of Vibrating Strings 56
Novel Electric Push Button and "Presselle" ... 56
Graphite Bearings for Pulleys and Shafting ... 56

NEW BOOKS:
The National Electric Light Association, Chicago Convention. 48
American Electrical Directory, 1889 ... 48

CORRESPONDENCE:
Priority in Laminating Armatures. By R. J. Hewett ... 48
A Compound Bell Magnet. By J. L. S ... 49
Mr. Harold P. Brown's Reply to Mr. Gutmann. By Harold P. Brown ... 57

EDITORIAL:
Paragraphs ... 47

MISCELLANEOUS:
On the Efficiency of Thermo-Magnetic Machines. By Ch. Steinmetz ... 48
Gas in New York Electrical Subways ... 50
Detecting Electrically the Proximity of Icebergs. By F. R. Colvin ... 51
On an Experimental Theory of the Lead Accumulator. By Leonard Paget, Ph. D ... 53
Wire Cable Welding by Electricity. By O. K. Stuart and A. M. Bullard ... 54
Reviving Exhausted Primary Batteries. By Ch. J. Miller ... 55
Automatic Accumulator Station in France ... 55
A Galvani Manuscript ... 56
A Gas and Electric Light Fixture Trust ... 56
Electromotive Force of Amalgams ... 56
The Electrical Execution Investigation ... 57
Electrical Engineering at Johns Hopkins University ... 57
The Electric Light Convention Train ... 57
Reporting the Recent Sullivan-Kilrain Prize Fight ... 57

SPECIAL CORRESPONDENCE:
New York Notes, 57; New England Notes, 58; Western Notes, 58; Southern Notes, 59; English Notes ... 60

DEPARTMENTS:
The Telegraph, 60; The Telephone, 60; The Electric Light, 60; Applications of Power, 60; Personals, 60; Miscellaneous, 60; Business Notices ... 60
Our Illustrated Record of Electrical Patents ... 61, 62

VOL. XIV. NEW YORK, JULY 27, 1889. No. 4.

American Belts in England. THE enterprise exhibited by the Westinghouse Company in establishing a central station in London with dynamos and machinery of American manufacture throughout is evidently to be carried out to the smaller, though not less important, details. The large order just given to one of our prominent belt manufacturers for equipping the London station would seem to indicate that even in this department America can supply the most exacting demands.

An Interesting Experiment. MANY curious phenomena have already been encountered in the study of the alternating current, and many, no doubt, are still to be brought to light. Among the more recent we note the effect of the alternating current on a stretched wire placed in a magnetic field, as illustrated in the simple experiment described in another column, and due to Professors Ayrton and Perry. The action there observed appears to be of value not only in the scientific examination of the alternating current, but seems also adapted for practical application in various ways.

Alternating Current Litigation. THE patent issued last week to Mr. Rankin Kennedy on the system of alternating current distribution will no doubt interest many of our readers, considering the rumor that it is intended to bring suit upon the same, by the Westinghouse Company, against others now in the field using the alternating current.

Thermo-Electricity. IN this issue we begin the publication of a short series of articles on thermo-electricity and its practical application to the construction of thermo-electric batteries. Mr. Rust has made a large number of experiments on various forms of thermo-electric couples, and has carried out his studies practically in the construction of a large thermo-electric battery, to be described in a subsequent issue. There is comparatively little literature available on this subject, and hence, although Mr. Rust is somewhat radical in his opinions on the action involved in the thermo-electric generation of current, his experiments will nevertheless prove of interest.

Storage Battery Reactions. THE various actions and reactions occurring during the charge and discharge of the lead-sulphuric acid storage battery have long been the subject of investigation and discussion, and each new fact brought out brings us nearer to the formation of a correct theory on this important subject. In referring to the experiments of M. Roux, Dr. Leonard Paget, in another column, points out that the results obtained experimentally appear to agree very closely with the theory that the actions within the storage battery involve the sulphating of both plates during the discharge of the battery, and that the peroxide plate is sulphated equally with the negative plate.

The Niagara Falls Meeting. THE indications are that the coming Niagara convention of the National Electric Light Association will be one of the best, both in point of attendance and in the interest attached to the papers to be read. Excellent arrangements have been made for the reception of the members, and it is expected that Mr. W. C. Ely, one of the leading citizens of Niagara Falls, N. Y., will deliver the address of welcome in the Orpheus Park Theatre, in the Casino Building, where the meetings will be held. The more solid work of the convention will be relieved by various excursions, and a hop in the evening of the second day is also on the programme. The special limited train, which leaves New York Aug. 5, at 9 A. M., via the Erie Railroad, will insure a most delightful trip.

Primary Battery Improvements. THE widespread use of primary batteries, notwithstanding the existence of the dynamo as an electric generator, makes it natural for inventors to seek to devise new forms or make improvements on those already in existence. Among the latter we note elsewhere the improvements recently introduced by Mr. P. B. Delany. Having in mind the inconvenience connected with the gravity battery in its present form, he has, by the simple addition of an envelope for the zinc and for the copper crystals, overcome what has heretofore been a source of much trouble and annoyance. Mr. Delany's simple method of preventing the creeping of the salts in batteries will, no doubt, also be appreciated by those who have been charged with the care of batteries in which this defect is prominent.

Electrical Cable Welding. EVER since the metallic cable has taken the place of the rigid bar or the chain, the mechanical engineer has been seeking a method of uniting successive cable lengths without materially decreasing the strength of the original sections. Where the joint was required to be practically of no greater cross-section than the original cable great difficulty has been experienced, and the strength of the cable has been invariably considerably reduced. But now the process of electric welding of Prof. Thomson has been applied to perform the difficult task, and with eminent success. The article by Messrs. Stuart and Bullard, in another column, shows that, with proper arrangements and the exercise of ordinary care, each strand of a cable may be united to that of another, end to end, so that the joint is practically imperceptible. The high percentage of the strength of the original section obtained by this method will undoubtedly make it the preferred one for all this kind of work.

Electric Detection of Icebergs. NO sooner had the news of the narrow escape of the "Saale" in her recent collision with an iceberg become known than suggestions from various quarters were offered for the prevention of such accidents. Most of these called attention to the fact that some electrical device could be constructed which would indicate the presence of icebergs at a sufficient distance to avoid a collision. In discussing the application of such methods, Mr. F. R. Colvin, in a very interesting article appearing on another page, shows exactly the conditions encountered in the application of such a device, and demonstrates, that while it might be a useful adjunct to a ship's equipment under certain circumstances, its action could not be depended upon at all times. The fault evidently does not lie in the apparatus itself, but in the conditions which exist respecting the currents surrounding an iceberg and involving the direction in which the ship approaches the latter. As suggested by Mr. Colvin, the best method of avoiding icebergs is to keep to a safe limit to the south, and the reason why this simple way out of the difficulty is not always followed is one that should not be allowed to longer prevail.

Care of Testing Instruments. NEWLY-FLEDGED electricians engaging in the manufacture of electrical apparatus are apt to forget in the hurry and bustle of increased commercial activity that too much care cannot be taken of sensitive electrical testing instruments. They thereby fail to reap the full benefit of these invaluable aids to perfect workmanship, as slight injury will often render re-calibration necessary. A few days ago two new and expensive instruments were resting in a small glass show-case, fully protected against all injury from dust or accidental stroke, yet when placed in circuit they could not tell the truth. Why? Because during many hours of each day they had been exposed to the direct rays of the sun beating through an open window into the glass case, that was closed so tightly as to allow of slight dispersion of the heat generated, which gradually reached a point indicated by a thermometer placed therein to be over 120 degrees Fahr. When attention was called to the possible evil effects of prolonged exposure the metal parts on one instrument were too hot to be comfortably handled. After noting a few cases of similar character, one cannot blame dealers for refusing to receive back or to exchange an instrument when it has once left the house.

Primary Battery Financing. WHILE there is some warrant for the investment of money in new primary batteries, as it is a field in which one sees steady improvement, there can be no excuse for the extravagant and misleading statements issued now and again in certain quarters to induce people to put money in a system that is now being exploited in the West and South for electric lighting by means of primaries. A card invitation put forth recently is headed, "The cheapest and brightest electric light in the world," and it is claimed the companies formed have a capital of $2,275,000. These corporations, it is further asserted, "have a monopoly in a perfected business, electric illumination without machinery, that is needed throughout the entire world." How the monopoly has been effected is not stated, but the prospective investor is informed that "one million of the lights can be rented in the United States within the next two years at a profit of 50 per cent. on the money invested." Successful plants are said to be in operation now in all parts of the country, but we have not yet been able to discover traces of any of them, nor do we ever expect to do so. We had hoped that there was now enough electrical ability everywhere to prevent schemes of the above nature from proving financially profitable to their projectors. In case any of our readers may have been asked to invest, we advise them to seek first the opinion of some local electrician who is engaged in telegraphy, telephony, electric lighting or similar pursuit, and in whom they can place confidence. Should they care to investigate the promoter's and alleged inventor's record in the East, they will not be likely to have much to do with him.

Activity in Electrical Circles. IT is a question whether all the electrical supply houses fully appreciate what a banner year 1889 is going to be for their business. Already contracts have been closed for the installation of electric plants that will require a total amount of supplies far exceeding the aggregate of any previous six months, and the prospective plants for which bids have already been tendered or will shortly be called for, and which will certainly be in operation before the new year, will make the total amount of material required and used run up into figures that will surprise every manufacturer and supply man. Already there is complaint of the immediate scarcity of select poles suitable for erection on residence streets, the numerous installations having used up the stock originally carried in the pole yard, and in consequence prices have risen slightly. There are plenty of good poles cut and piled in the forest, but the delay required in obtaining cars and shipping causes annoyance when the time specified in a contract is limited. Oak pins are being turned out as fast as possible, and a large stock of insulators has been secured, but it is probable that contractors will experience some delay in securing shipments before the year ends. There has been a scarcity of certain sizes of copper wire every fall during the last four years, and this year will prove no exception. This great demand not only affects the manufacturers and dealers in line construction material, but has also increased the activity among the makers of steam plants and all thereto pertaining, as the older lighting plants are rapidly extending their circuits, and requiring in certain cases several hundred horse-power extra per plant; the smaller towns of 1,500 or 2,000 inhabitants are demanding electric lights; in the larger cities extensive electric motive power plants are being constructed, and in many cities of all sizes the street railway companies are rapidly adopting an electric motor system.

NEW BOOKS.

The National Electric Light Association—Chicago Convention. Boston, Mass. Press of *Modern Light and Heat*. 1889. 261 pages.

This official report of the preceedings at the Chicago Convention last February makes its appearance with exemplary promptitude. It appears, too, in an excellent form, and is rendered durable by the addition of a handsome cloth cover, which is a marked improvement over that of paper hitherto used.

With the subject matter still so fresh in their memories, we need not remind our readers that the papers and discussions at Chicago were highly valuable as contributions to practical knowledge on the various questions connected with electric lighting. Reference to any particular topic and to what was said about it is rendered easy by the copious index at the end. Altogether, Secretary Garratt is to be congratulated upon the good showing and upon the good work the Association is doing.

American Electrical Directory. Fort Wayne, Ind., Star Iron Tower Company. 1889. 998 pages. Price, $5.

This volume, in heavy cloth cover, and close upon one thousand pages, is a massive and imposing publication. It is put together on the same lines as its predecessors, but several additions have been made to the contents. Heretofore the directory has been limited to electric light companies, parent and local, and some of the construction companies, but in this issue electric railway companies are also included. We note also that the lists of companies and individuals are supplemented by the rules of the New England Insurance Exchange, the New York Board of Fire Underwriters, and the New York Board of Electrical Control, and by some interesting tables and formulæ. We observe, too, a valuable table of the prices of gas in various cities. The directory is a valuable work, and reflects great credit on the enterprising concern that has published it.

Ferranti Alternating Machines at the Paris Exhibition.

We have already described in these columns the Ferranti alternating machines and apparatus now in operation in London, and being installed at the Deptford station there. The system is also on exhibition at Paris, and what is there shown may be considered to be the latest development of that type of generator and method of distribution.

Our illustration, Fig. 1, taken from *La Nature*, represents the Ferranti machine in end view, and Fig. 2 shows the same with the magnets withdrawn, exposing the armature. The machine is set up in the space of the Société l'Eclairage Electrique on the banks of the Seine near the Pont d'Jena, and the most remote lamp fed by it is at a distance of two kilometres.

The electrical details of the machine do not differ from those already described by us, but in the machine exhibited at Paris the exciter of the field magnets is directly attached to the shaft of the machine, as shown in Fig. 1, and consists of a Thury dynamo delivering 27 ampères at 90 volts.

The generator itself is capable of furnishing 50 ampères

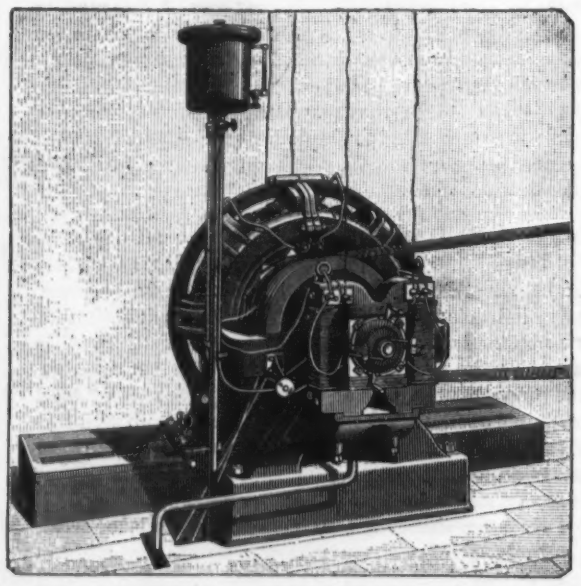


Fig. 1.—Ferranti Alternator and Exciter, Paris Exposition.

at 2,400 volts, or 120,000 watts, revolving at a speed of 500 revolutions per minute.

The lubrication of the machine has been specially provided for, a constant flow of oil being maintained on the bearings. For this purpose a small centrifugal pump placed below the floor forces the oil into a reservoir above, shown beside the machine, from which the oil flows to the bearings under pressure.

The distribution board employed in Paris is shown in Fig. 3. Upon it are mounted three main switches at the left, and six fusible cut-outs. These cut-outs are placed in porcelain troughs, in the bottom of which the fusible wire is placed, the whole being covered by a lid, also of porcelain.

The character of the work done at the Exposition by the Ferranti machine is quite varied. Thus we find in one place incandescent lamps fed at 100 volts, and at another at 65 volts. At still another place the current from the same machine feeds Sunbeam arc lamps at 50 volts. The Ferranti system is thus demonstrated to excellent advantage at the Paris Exposition.

On the Efficiency of Thermo-Magnetic Machines.

BY CH. STEINMETZ.

In The Electrical World of April 27, pages 241 and 242; May 4, pages 255 and 261, and May 18, page 281, I read some essays on the problem of thermo-magnetic

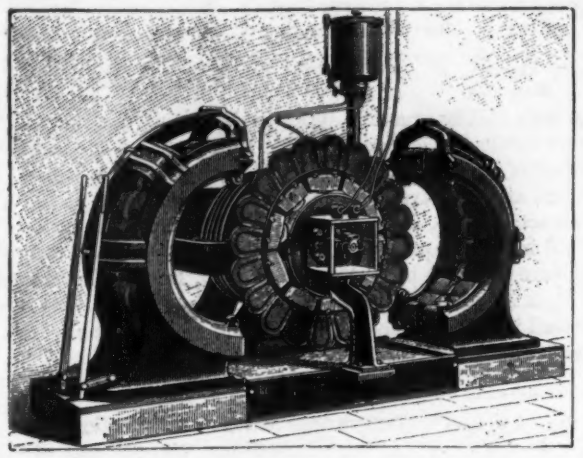


Fig. 2.—Ferranti Alternator, Paris Exposition.

machines, and the question most essentially belonging to them, relating to the work necessary to produce magnetism.

Some time ago, during a stay in Switzerland, while I was busy writing a "Theory of Transformers," at the request of Mr. Uppenborn, editor of the *Centralblatt fuer Elektrotechnik*, of Munich, Germany, I happened to come across the above question, and followed it up. In the course of my researches, I arrived at the following facts:

To ascertain the amount of work consumed in magnetizing iron, let us commence by considering the actions which occur when an electro-magnet is being magnetized.

When a current of electricity magnetizes an electro-magnet, the current has to do a certain amount of work for that purpose. Now the whole amount of electric energy consumed by the electro-magnet is the product of the potential and the current intensity $= p\,c$.

The electric energy converted into heat is $= C^2R$. (R = resistance of the magnetizing coils.) This latter energy C^2R is smaller than $p\,c$. The difference of the two is the energy consumed in magnetizing the iron of the electro-magnet. That is to say, we have the following equation:

$$C\,\eta = C\,p - C^2R, \qquad (1)$$

η being the counteracting electromotive force of magnetization (polarization).

Now, let I denote the intensity of the magnetic field inside of the electro-magnet; let f be the cross-section of the iron; l, the length of each magnetizing coil; n, the number of coils.

For the total magnetism, we then have the equation:

$$f\,I = k\,n\,l\,c \qquad (2)$$

where k is a coefficient of magnetic induction.

The (counteracting) electromotive force of magnetization is:

$$\eta = n\,f\,\frac{d\,I}{d\,t}, \qquad (3)$$

where t indicates the time.

Combining (2) and (3) gives us:

$$c\,\eta = \frac{f^2}{k\,l}\,l\,\frac{d\,I}{d\,t} = \mu\,I\,\frac{d\,I}{d\,t}, \qquad (4)$$

where μ stands for $\left(\frac{f^2}{k\,l}\right)$.

On the left side we have the electric energy converted into magnetism; on the right there is the magnetic energy absorbed by the iron.

Therefore:

$$\int c\,\eta\,d\,t = \int_{I_0}^{I_1} \mu\,I\,\frac{d\,I}{d\,t}\,d\,t = \frac{\mu}{2}\left\{I_1^2 - I_0^2\right\}, \qquad (5)$$

if η in this range of time is constant; if not, μ means an average taken from the different values of it, inside of the above range of time.

"*The differential of work performed when magnetizing iron is* $= \mu\,I\,d\,I$." (6)

"*The magnetic work consumed in altering the intensity of the magnetic field from* I_0 *to* I_1, *is* $= \frac{\mu}{2}\left\{I_1^2 - I_0^2\right\}$" (7)

These equations shall aid us in our researches upon the subject of thermo-magnetic machines.

Let us commence with the most general case, that is, when electric or mechanical energy is produced by altering the magnetic state of the iron masses in the magnetic field, brought about by the alteration of the temperature.

If the alteration of temperature $= d\,h$, the alteration of the induced magnetic field of the iron $= d\,I$.

The magnetizing work is then $= \mu\,I\,d\,I$, (6)

and the work consumed in raising the temperature of the iron is $= g\,m\,a\,d\,h$; (8)

where

g is the specific heat of iron;

m the mass of the iron, and

a the mechanical equivalent of heat.

The total amount of work performed by the heat is then:

$$d\,L = \mu\,I\,d\,I + g\,m\,a\,d\,h, \qquad (9)$$

and consequently *:

$$L = \frac{\mu}{2}\left\{I_1^2 - I_0^2\right\} + g\,m\,a\,(h_1 - h_0). \qquad (10)$$

Only the first part of this work is available in the machine; the second part is to be considered as lost work, it having been consumed in altering the temperature in order to alter the magnetic state of the iron.*

The thermo-magnetic machines would therefore show the highest efficiency if, over a small range of temperature, the alteration of the intensity of the magnetic field were very large (Hopkinson, The Electrical World, May 4, page 261).

But the caloric energy, developed by a certainty quantity of heat Q, in passing from the temperature h_1 to h_0 (taking the absolute temperature, where zero lies at $-273°$ C.) is given by the equation:

$$L = Q\,a\,\frac{h_1 - h_0}{h_1}, \qquad (11)$$

and for an ideal or perfect thermo-magnetic machine we should, by combination of (10) and (11) have the equation:

$$Q\,a\,\frac{h_1 - h_0}{h_1} = \frac{\mu}{2}\left(I_1^2 - I_0^2\right) + g\,m\,a\,(h_1 - h_0);\ \text{or,}$$

$$\frac{\mu}{2}\left\{I_1^2 - I_0^2\right\} = (h_1 - h_0)\,a\left\{\frac{Q}{h_1}\,g\,m\right\}. \qquad (12)$$

That means that we have again come to the old and well-known fact that, for a small range of temperature, the work done by a certain quantity of heat Q is also very small. The consequence hereof is, that *thermo-magnetic machines also work the more economically, the greater the range of temperature is over which they are working.*

On the other hand, the deductions made in the issue of May 4, page 261, with regard to the constant increase of lost energy, still remain in full force, and therefore it seems that there is as little hope of reaching a higher degree of efficiency by the direct conversion of caloric into electric energy (or from caloric through magneto-electric into mechanical energy) by means of the methods at present adopted, as there is by means of thermo-electric batteries.

Priority in Laminating Armatures.

To the Editors of The Electrical World:

Manufacturers and users of laminated armatures may take some comfort by reading the following note, which was published in the *Telegraphic Journal*, page 271, Vol. I., 1873, London: "Electrical Science in Foreign Journals. Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, Vol. LXXVII., No. 9. Note on Siemens' Bobbin. By M. A. Pellerin.—The Siemens' bobbin has a great inconvenience, that it gives rise, in the machines in which it is employed, to a considerable development of heat, and consequently a corresponding loss of work. It is possible that the origin of a greater part of this heat is in the induction currents developed by the movement in the mass of metal forming the core of the bobbin. We avoid the production of these currents by forming the core of discs of *soft iron insulated*. The assemblage of these discs in a sufficiently solid mass is not an insurmountable difficulty."

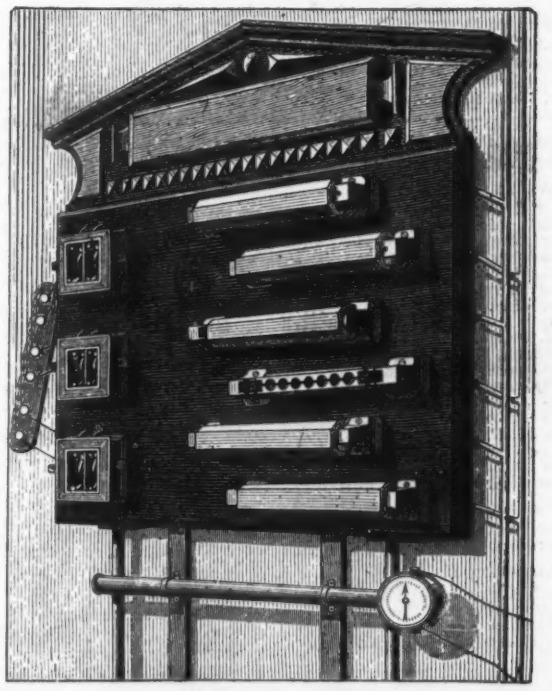


Fig. 3.—Ferranti Switchboard, Paris Exposition.

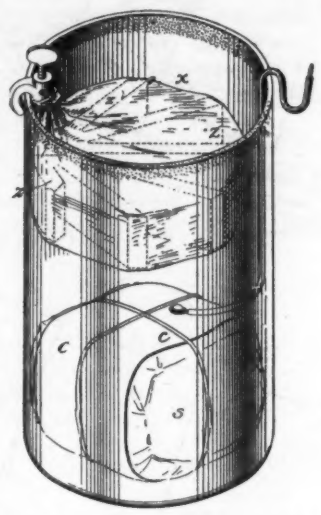
This note appears to set forth very plainly the cause and the remedy of everything that is covered by the recent patent of Weston. Surely it is only a step from a laminated Siemens bobbin to the laminated armatures of all types in use to-day.

R. J. Hewett.

* We are not even allowed to consider the whole of the first part of this work as available; for, taking into consideration the phenomena of *remanent or residual magnetism* and of *hysteresis*, we should have to deal with another subtractive part in the equation (2), of the importance of which nothing can be predicated at present. To deal any further with these undefined problems would lead us too far. Their fundamental importance for transformers I have tried to show in my "Theorie der Transformatoren" (Theory of Transformers) in the *Centralblatt fuer Elektrotechnik*.

Delany's Improved Gravity Battery.

Notwithstanding the great value of the well-known Callaud gravity battery, its use, nevertheless, entails some inconveniences which, though long recognized, have not as yet received the attention which the widespread use of the battery would seem to warrant. Principal among these are the frequent cleaning required by the battery when worked hard, as well as a number of minor difficulties due to the nature of the cell. In order to overcome these defects, Mr. P. B. Delany, of this city, the well-known inventor of the synchronous multiplex telegraph system, has recently introduced a number of simple but ingenious



DELANY'S IMPROVED GRAVITY BATTERY.

improvements in this type of cell, by which its efficiency is considerably increased.

The accompanying engraving shows the manner in which this is accomplished. As will be seen, the ordinary zinc electrode is inclosed in a loose sheet or bag *z* of some porous material, such as common cotton cloth, and in a like manner the sulphate of copper crystals are placed within the porous bag *s*, surrounded by the strip of copper *c*, which is connected to the wire terminal passing out of the liquids.

Among the advantages obtained by the use of this arrangement may be mentioned that when the cell is first set up the sulphate of copper crystals, being divided from the liquid by porous material, does not dissolve sufficiently to penetrate the covering for some little time, and then they dissolve comparatively slowly, so that the cell being in position and the fluid quiescent, the sulphate of copper solution, by reason of its greater specific gravity, remains at the bottom, and is not diffused through all the fluid in the jar, as is otherwise apt to be the case, and cause the deposition of copper on the zinc, coating it and producing local action, and affecting the potential and general efficiency of the battery. On the other hand, when the cell becomes active, the porous covering on the zinc protects it from the hydrogen gas which constantly arises from the copper electrode, carrying with it sulphate of copper. The covering also prevents stalactite formations of copper on the zinc, which occurs in the ordinary gravity battery and goes down into the solution of sulphate of copper, solidifying it so as to frequently render the removal of the copper electrode difficult without breaking the jar. The covering also retards the dissolving of the sulphate of copper and an unnecessarily free action upon the zinc and wasteful supersaturation.

Mr. Delany has found by actual test that after three or four days, when the two elements, sulphate of copper and sulphate of zinc, have been produced to a proper working extent, the resistance of the battery is no higher and the current is even greater than with batteries of the ordinary form.

A very important consideration, from an economic standpoint, is the increased longevity of the battery, due to the conserving effect of the porous covering. Thus, comparative tests already made show that the new battery will last nearly one-third longer than the ordinary cell with the same weight of zinc and copper sulphate at starting. In the improved form of battery, when the first charge of sulphate has been used up completely, the supply-bag is thrown away, and it is only necessary to put another charge in the copper band. The zinc is put back without disturbing the cover; for, unlike the zincs of the ordinary battery, these do not require scraping or cleaning. The protection against copper sulphate afforded by the covering and the concentration of zinc in solution around the metallic zinc prevents the hard coating from forming on the zinc, so that the supply of sulphate of zinc is ample until the metallic zinc is reduced to impracticable proportions.

Another advantage lies in the firmness with which the copper electrode is held in position. Much trouble and annoyance is now experienced by this electrode being pulled out of position and the difficulty of getting it back again, owing to the crystals getting under it. By reason of this defect the resistance of cells of the same battery is often widely different and constantly subject to change.

Mr. Delany has found a paper envelope to be suitable for inclosing the zinc and a strawboard box best suited for the sulphate of copper crystals. The resistance of the battery may be varied by the character of the covering.

Still another improvement has been introduced in battery work by Mr. Delany, which consists in roughening or sanding the interior rim of the glass jar, as shown in the illustration. This is done by coating the interior lip of the jar with asphaltum varnish, for instance, and then applying ordinary white sand. It has been found that with such an arrangement the liquid of the battery will not creep up to and over the edge of the jar. This is a material advantage, as all who have had any experience with this and other forms of battery will at once recognize. This application is equally effective for Leclanché cells. Of the 100 cells in Mr. Delany's office thus treated six months ago, not one shows the slightest trace of salt creeping.

The Thomson-Houston Exhibit at the Paris Exposition.

(From Our Special Correspondent.)

PARIS, France, July 2, 1889.—The exhibit made by the Thomson-Houston Electric Company, of Lynn, Mass., is an exceptionally fine one. The principal display is in Machinery Hall, but there are branches or annexes in the railway, the industrial and the agricultural departments, each of which is highly interesting. Prof. Elihu Thomson's personal exhibit is in the industrial section, and contains working models of many of his inventions, while several of his laboratory experiments on magnetism and induction are very prettily shown. His alternating current meters and motors, together with many appliances for practical electric lighting with high tension alternating currents are here shown, and the exhibit is quite striking in magnitude and importance. In fact, both Mr. Thurnauer and Mr. Parsons are to be congratulated on the way the Thomson-Houston exhibit is put together, as they have contrived to make the most of the space allotted to them. The display in Machinery Hall fronts on the main aisle, and contains machines for the various systems for transmitting electricity, for light and power. The Thomson electric welder is given a prominent place, and here every day, from two to four o'clock, the public is treated to the strange sight of welding metals by electricity. The welder is run by a special 12 × 12 Armington and Sims engine, and welds anything, from No. 36 copper wire to 2½-inch bars of steel, with the greatest ease. Near by is the largest dynamo made by the Thomson-Houston Company. It is known as the No. 25 generator, and has an output of 125 ampères at 500 volts. It is a compound wound machine, with the series winding in a coil wound about the extremities of the pole pieces acting as an automatic regulator in a circuit having a certain drop of potential.

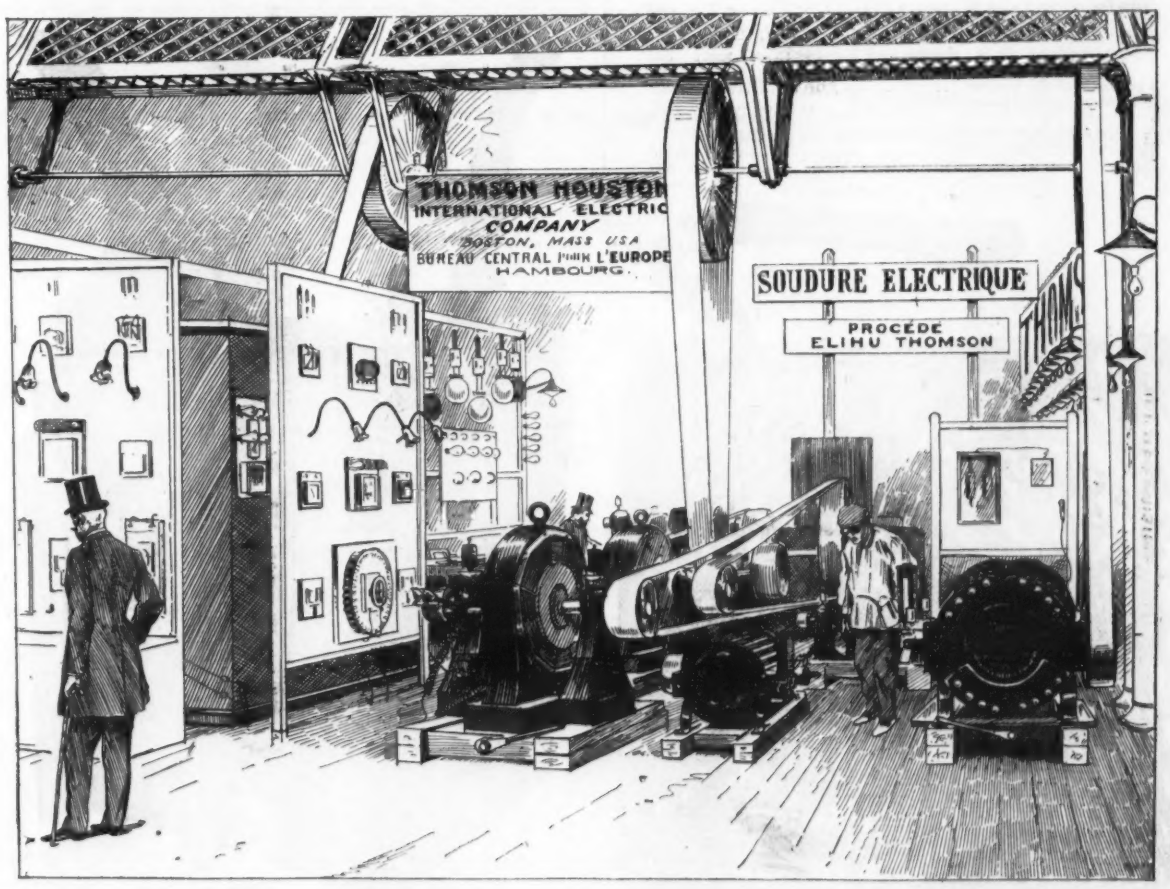
It is used principally for railroad work, in the present case supplying current to motors in the Agricultural department, which I will describe presently. Close to this machine is the smallest incandescent dynamo made by this company, marked No. 0, and giving 12 ampères at 110 volts. It is also compound wound, and has the series coil about the pole pieces exactly like the large machine.

Here is also to be seen the Thomson-Houston fifty lighter. These fifty lights are of 2,000 c. p. each, and the machine is the largest arc dynamo the company builds. Near it is the smallest arc dynamo, which will operate three 2,000 c. p. lamps.

Alternating current machines are given a prominent place in this exhibit. One 500-light 1,000-volt alternator operates a combined street and house-to-house system of distribution. Taps are taken off in multiple from the line, and passed through converters which reduce the potential to 52 volts before entering a building. The street lights are run in series from one pole at the machine to the other pole at the end of the line. Here at the Exposition the converters are placed in the American industrial section, where Prof. Thomson's exhibit is thus lit, and the municipal or street lights, forty in number, are placed around the Machinery Hall space. There is another alternating machine of 600-light capacity and 330 volts, operating a double three-wire system, giving 75 volts at the lamp. A compensating resistance is brought into circuit when a lamp goes out or is turned out, automatically keeping the pressure constant on all four circuits. The four handsome switchboards are each devoted to a different system. One is for the 50-light arc machine, the second for the 1,000-volt alternating, another for the 330-volt compensating, and the fourth for the 500-volt railway dynamo supplying current to the Department of Agriculture. This last named exhibit is to me the most interesting exhibit of all, as it is a combination of machines which demonstrates the facility with which electricity can be transmitted from a distance and be converted into power at a centre of distribution. The current from the 500-volt dynamo in Machinery Hall is carried down to this section by wires on neat iron poles about 20 feet high, along the Avenue Bosquet, the line being nearly a mile in length. This current drives a 500-volt 40 h. p. motor, which is in turn belted to a 250-volt dynamo. This 250-volt current on its way to the mains passes through a machine of the standard Thomson-Houston incandescent pattern, but whose armature is supplied with two commutators. In fact, it has a double-wound armature and is a combined motor and dynamo. It is used as a compensator on a three-wire system running a large number of small motors operating farming implements. When the load is less on one side of the system than the other, the pressure will rise on that side and accelerate the speed of the compensating armature sufficiently to generate a higher electro-motive force on the other side.

Professor Thomson, who was here recently for a week, has gone on a trip in search of health and enjoyment among the mountains of Switzerland, and will not return here until the time of the conference of electricians in August.

E. W. H.



THE THOMSON-HOUSTON EXHIBIT AT THE PARIS EXPOSITION.

A Compound Bell Magnet.

To the Editors of The Electrical World:

Would you kindly inform me what the result would be of a magnet made of alternate layers of insulated copper wire and sheet iron, the sheet iron being joined together at the ends and with the central bar magnet.

J. L. S.

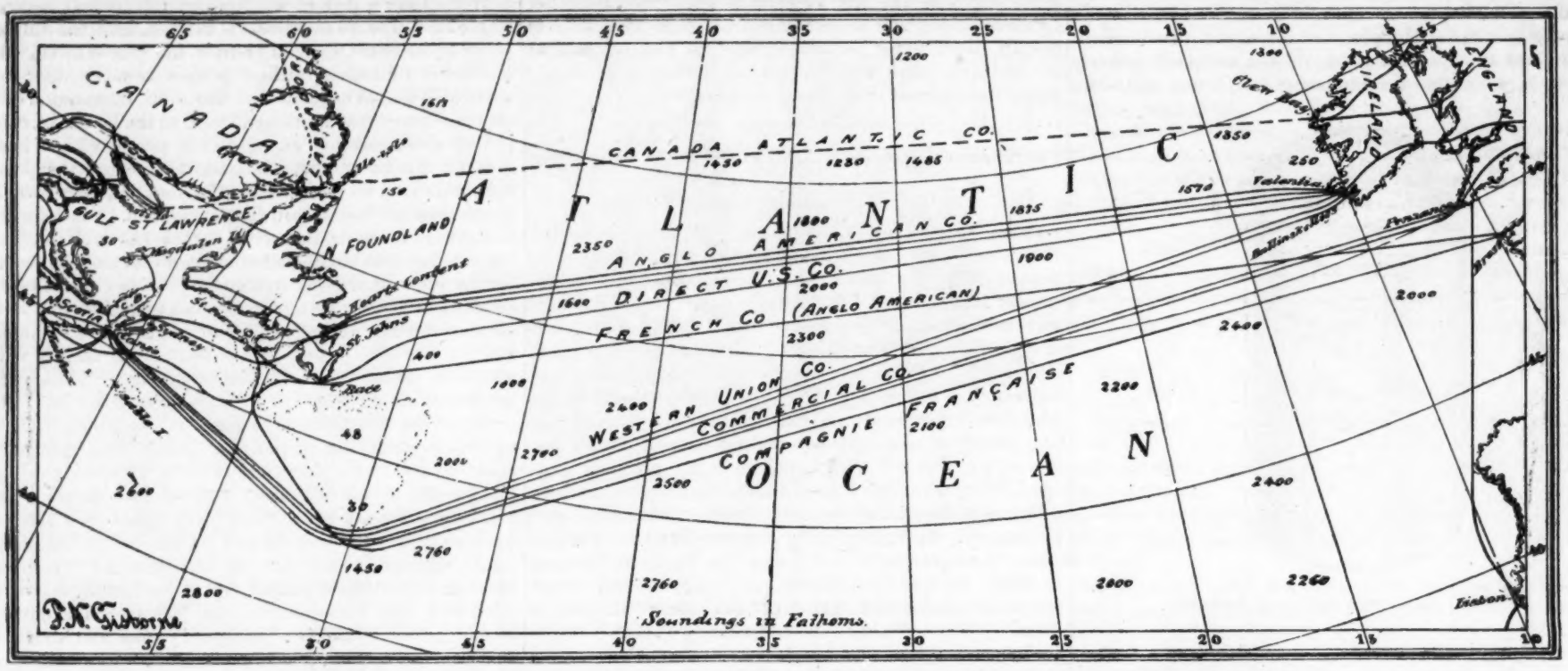
CHICAGO, Ill.

ANSWER.—A magnet so constructed is said to be much stronger than one of the ordinary kind. This probably relates more particularly to its portative force, or lifting power. Magnets of this kind were first made by Comacho, and a magnet of this type was patented in this country by S. G. Cabell, of Quincy, Ill., June 25, 1867, No. 66,001.—EDS. E. W.

Trans-Atlantic Cable Routes.

Considerable discussion is now going on in Atlantic cable circles respecting the proposed Canada Atlantic cable, which which it is proposed to carry through the Straits of Belle Isle, thus avoiding proximity to cables already laid, and offering a shorter route.

The accompanying map shows the relative lengths and approximate positions of trans-Atlantic cables in present operation; also, the proposed Canada Atlantic cable:



MAP SHOWING LOCATION OF EXISTING CABLES AND THE PROPOSED CANADA ATLANTIC CABLE.

THE ANGLO-AMERICAN COMPANY'S CABLES.

Laid.	Between.	Nautical miles.	
1873.	Ireland and Newfoundland	1,881	
"	Newfoundland via St. Pierre and Cape Breton	293	
			2,174
1874.	Ireland and Newfoundland	1,840	
1873.	Newfoundland and Sydney, C. B	343	
			2,183
1880.	Ireland and Newfoundland	1,886	
"	Newfoundland via St. Pierre and Cape Breton	360	
			2,246
1869.	France and St. Pierre	2,648	
"	St. Pierre and Massachusetts, U. S	759	
			3,407

THE DIRECT UNITED STATES COMPANY'S CABLES.

1874.	Ireland and Nova Scotia	2,423	
"	Nova Scotia and New Hampshire, U. S	560	
			2,983

COMPAGNIE FRANCAISE DE PARIS A NEW YORK.

1879.	France and St. Pierre	2,242	
"	St. Pierre and Cape Breton	188	
"	St. Pierre and Massachusetts, U. S	827	
			3,257

THE WESTERN UNION COMPANY'S CABLES.

1881.	England and Nova Scotia	2,531	
1882.	England and Nova Scotia	2,576	

THE COMMERCIAL COMPANY'S CABLES.

1884.	Ireland and Nova Scotia	2,350	
"	Nova Scotia and New York, U. S	841	
			3,191
"	Ireland and Nova Scotia	2,388	
1885.	Nova Scotia and Massachusetts, U. S	519	
			2,907

THE CANADA ATLANTIC COMPANY'S CABLE (PROPOSED).

1890.	Ireland to Straits of Belle Isle, Can	1,900

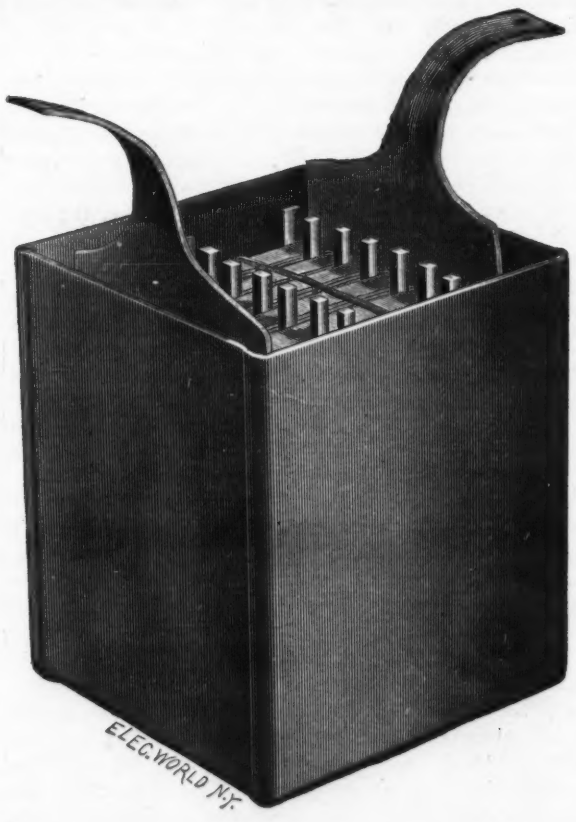
The representative expenditure or share capital of the foregoing companies is approximately as follows:

Anglo-American	$35,000,000	Each	line	$8,750,000
Direct United States	6,400,000	"	"	6,400,000
Compagnie Française	8,400,000	"	"	8,400,000
Western Union	14,000,000	"	"	7,000,000
Commercial	8,000,000	"	"	4,000,000
Canada Atlantic	1,600,000	"	"	1,600,000

In commenting on the proposed cable the *Dominion Illustrated* estimates that the profitably serviceable continuity of the foregoing cables will be twenty years for the older and twenty-five for the later types, last year's costly experience in repairing the Anglo-American French cable of 1869 being cited as confirmatory of the former calculation.

One decided advantage claimed for the new cable is that the Belle Isle route will be over 150 miles northward of any trans-Atlantic cable now laid, and the depth of ocean, according to the map, will be considerably less; it will thus be free from all risks during the repairs of other cables, and can be more readily raised when required. Besides this, the company will only have to provide and maintain the main cable or cables, of not exceeding 1,900 miles in length, the connection eastward being with the Imperial Government Post-Office telegraph service, and westward with the Canadian Government telegraph service at Greenly Island, in the Straits of Belle Isle. Hence, the company will be at no outlay of capital for terminal cables, and no pooling pressure, etc., is practicable.

The capital expenditure of the company will, it is estimated, not exceed $1,600,000, one of the principal cable manufacturing companies in London having tendered to provide, lay and guarantee a cable of the most approved type for the sum of $1,500,000, thus reducing the cost much below that of the cables already laid.



FIGS. 1, 2 AND 3.—THE NEW SORLEY STORAGE BATTERY.

Efficiency of Pyro-Magnetic Motors.—In the abstract of the thesis of Mr. Geo. D. Shepardson, entitled "Electricity from Heat," and republished in a recent issue from the Cornell *Crank*, the theoretical efficiency of the pyro-magnetic motor was given as .016. This was an error in the abstract, the figure intended being 0.16, according to the provisional theory of the author.

The New Anglo-American Storage Battery.

The accompanying illustration represents a form of storage battery designed by Mr. Charles Sorley, now being manufactured by the Anglo-American Electric Light Company, of New York, and being introduced in Chicago by the Illinois Anglo-American Storage Battery Company.

The object aimed at in the construction of this cell has been to obtain as large an amount of active material as possible with a large conducting and contact surface. For this purpose the plates of the cell are constructed as shown in Fig. 1, being built up of lead strips which are bent into the shape shown and united into a plate. The active material occupies the interstices left by the convolutions and is thus prevented from falling out.

The plates are put together as shown in the engraving, Fig. 2, being supported by insulating strips and bound together by insulating rods which pass through the centre. The plates rest on insulating feet, and the cell complete is shown in Fig. 3.

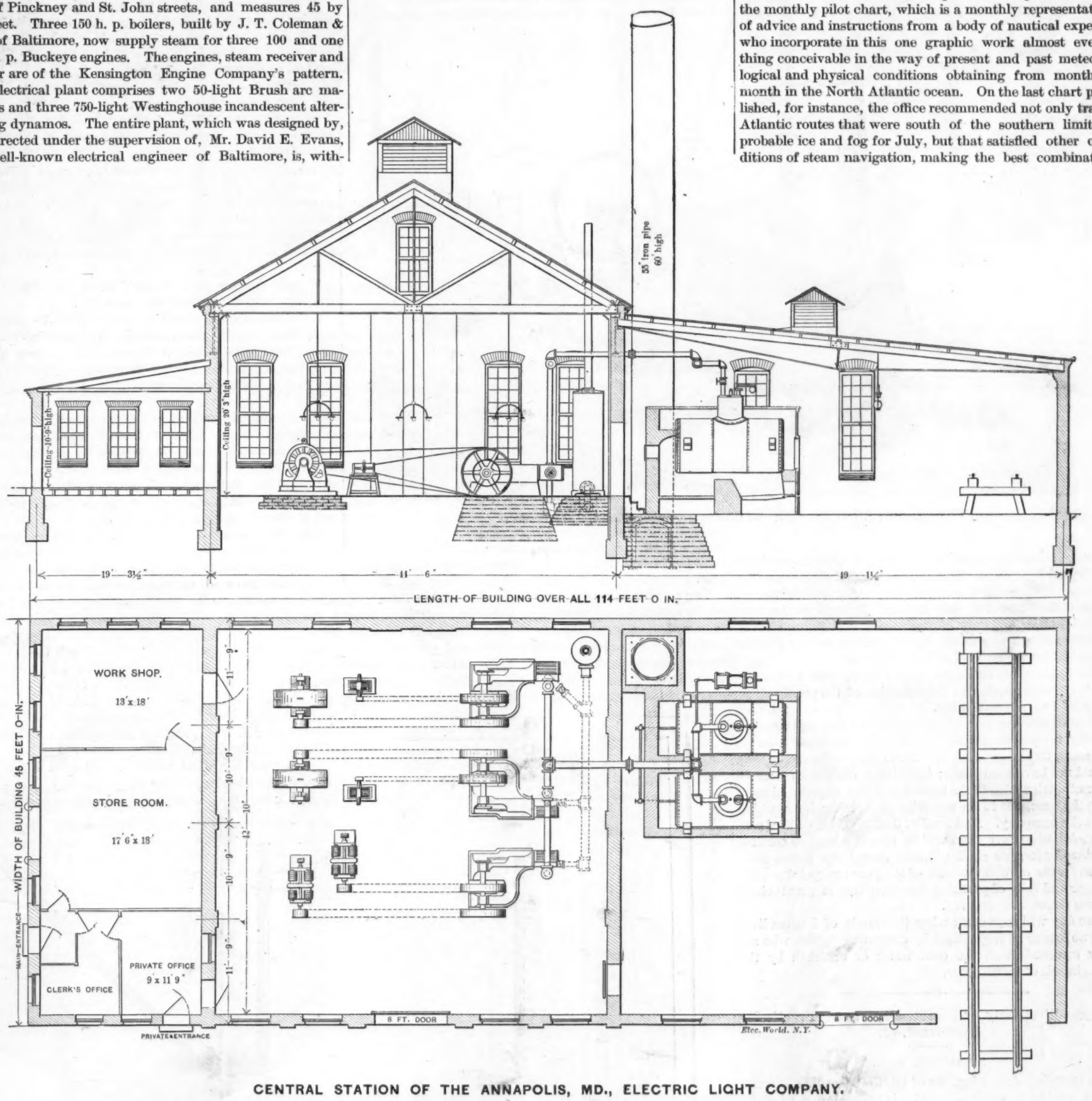
Gas in the New York Electrical Subways.

Dr. Edward A. Martin, chemist of the Health Department, made a report to the board last week in relation to the electrical subways in this city, in which he says that there are about 1,100 miles of gas mains in the city. The leaky joints and imperfections in these mains allow nearly 10 per cent. of the gas made to escape into the earth and air. Dr. Martin says: "About 8,660,000,000 cubic feet of gas was made during the past year, 10 per cent. of which would be 866,000,000 cubic feet. A large amount of this leakage finds its way into the subways. Many of the complaints of gaseous odors in this city are, in my opinion, due to the gas escaping from the electrical subways. The danger of explosions, should the gas accumulated in the sub-

ways be ignited, is great." Dr. Martin recommends that the electrical subways be properly ventilated, to prevent the dangerous accumulation of illuminating and other gases, but he does not suggest any definite plan for such ventilation.

The Annapolis, Md., Central Station.

Annapolis, the capital city of Maryland, is now the happy possessor of an exceedingly neat and well-arranged electric light station. The current was turned on for the first time on the night of July 1. The building is situated on the corner of Pinckney and St. John streets, and measures 45 by 114 feet. Three 150 h. p. boilers, built by J. T. Coleman & Co., of Baltimore, now supply steam for three 100 and one 120 h. p. Buckeye engines. The engines, steam receiver and heater are of the Kensington Engine Company's pattern. The electrical plant comprises two 50-light Brush arc machines and three 750-light Westinghouse incandescent alternating dynamos. The entire plant, which was designed by, and erected under the supervision of, Mr. David E. Evans, the well-known electrical engineer of Baltimore, is, without doubt, the most complete in the State outside of Baltimore. It is operated by the Annapolis Electric Light Company, and starts out with a five-year city contract.



CENTRAL STATION OF THE ANNAPOLIS, MD., ELECTRIC LIGHT COMPANY.

Detecting Electrically the Proximity of Icebergs.

BY FRANK R. COLVIN.

The last narrow escape of the steamer "Saale" from sinking while in collision with an iceberg, has probably impressed many thoughtful minds in two ways: First, they ask, why is it necessary for such great steamers to shape their course so far to the northward? The second question that arises is, why could not some electrical device of a thermostatic nature be employed that would give the alarm to the "officer of the deck" in fair weather and foul, and in time to render collision with an iceberg impossible?

In discussing the second point with a well-known naval officer (a former associate and shipmate of mine), I obtained from him data concerning the first which has never as yet been thoroughly understood, and which discloses a state of of affairs in the matter of transatlantic routes of our steamships that will certainly be interesting if not reassuring to prospective passengers.

There would be no difficulty in perfecting an electrical thermocall that would be especially adapted for use on board ship, and that would ring an electric alarm in as many parts of the vessel as required when the temperature of the sea water reaches a certain degree. Such a device would be useful, and no doubt in many cases effective, but would it be reliable? Let us see. It is well known that owing to the specific gravity of ice, by far the greater portion of the berg is submerged, and it is clear that the effect of the wind and the upper current of water are almost insensible when compared with the force of that undercurrent which acts upon the greater area of the submerged mass. It is also clear, then, that a body of ice is frequently moving in one direction, while the upper current of water has a motion directly opposite, or perhaps nearly so. Therefore a vessel equipped with the most sensitive thermostatic apparatus, and implicitly depending upon its action, might rush down unconsciously, with the warm current of water, upon an iceberg which would be moving towards it, impelled by a current far below the ship's keel. In this case the device would be worse than useless, as its very employment might inspire a confidence in safety not warranted by the conditions to be met. There are cases on record where the water has become actually warmer on the near approach to an iceberg, though, of course, the temperature of the sea water is usually a pretty good guide.

Some of the fast ocean steamers cannot come to a full standstill in the water from full speed inside of two miles; there are probably none that can do so inside of a mile. These are rather startling statements when one considers the angle subtended by a large mass of ice for the first time visible only a few yards distant in a fog, with the vessel steaming toward it that is unable to stop on account of her inertia, and which cannot avoid it on account of her great tactical diameter (the diameter of the circle a ship would describe going ahead at full speed with her helm hard over).

The obvious deduction from all this is that the trans-Atlantic routes for steamers should be south of the probable limit of ice, varying in different months of the year with the limits for those months. Our government goes to considerable and well-warranted expense in the publication of the monthly pilot chart, which is a monthly representation of advice and instructions from a body of nautical experts, who incorporate in this one graphic work almost everything conceivable in the way of present and past meteorological and physical conditions obtaining from month to month in the North Atlantic ocean. On the last chart published, for instance, the office recommended not only trans-Atlantic routes that were south of the southern limit of probable ice and fog for July, but that satisfied other conditions of steam navigation, making the best combination of safety and speed. The route to the westward which was recommended is briefly the following track, or nothing to the southward of it:

W. 10°	N. 51° 10′
20°	50° 10′
30°	48° 12′
40°	45° 10′
47° 20′	42° 00′

Thence taking the great circle which crosses 50° W. in 42° 05′ N., 60° W. in 41° 42′ N., and 69° W. in 40° 38′ N.; from this last position vessels should keep well in endeavoring to cross 74° W. in 40° 30′ N. The other course, that for eastward-bound vessels, is some distance to the southward of the above, and is worked out with equal accuracy and refinement.

Why do not the steamship captains, to whom these charts are freely sent every month, follow them? They will not talk very freely on this subject to an inquirer, and should they hint that they are following the wishes of their companies, the security of their position as commanders might suffer. On the other hand, the companies' agents will say: "We authorize our captains to follow a perfectly safe

course, and under no circumstances to go farther north than latitude so-and-so in longitude so-and-so, unless in their judgment it is necessary to do so, etc." What does that mean to the captain? If he follows these instructions he makes a slow trip, because such a course will necessarily take him away from the shortest possible route, viz., the great circle course from the Banks of Newfoundland to Fastnet light. What does a slow trip mean? It means that some other commander will soon be found in whose judgment it *will* be "necessary" to exceed the nominal limits imposed by the agent. There is probably not a captain at sea to-day who would voluntarily take, trip after trip, a course too fa to the northward, as such a course would only mean hours of fatigue and anxiety on the bridge while the vessel is passing through the great fog banks. The northern course is adopted because, in the mad rush for fast time across the Atlantic, the steamship companies are taking advantage of the fact that there are only so many icebergs on the way, and that these are only of such a size, and the chances of striking one are very small, indeed, when mathematically expressed by the method of least squares.

The facts briefly summarized are, then, that a thermo-static electrical device for the detection of the proximity of ice would be a good thing, though not always reliable; that from the very fact of the number of icebergs reported weekly to the hydrographic office by the trans-Atlantic steamers, their course lies too far to the northward or they would not have seen them; that these dangerous courses are not attributable to the ambition of the captain himself to make time, but to the necessity of holding his position with the company. And finally, that the best ends of safe trans-Atlantic navigation will be served when the coming Marine Conference shall officially decree the routes to be taken for the different months of the year and point out the danger and folly of pursuing the approximate great circle course through ice and fog.

The day will soon come when thousands of human lives will no longer be jeopardized by competing agents who are now screened from the cold water of criticism by the mackintosh of indifference.

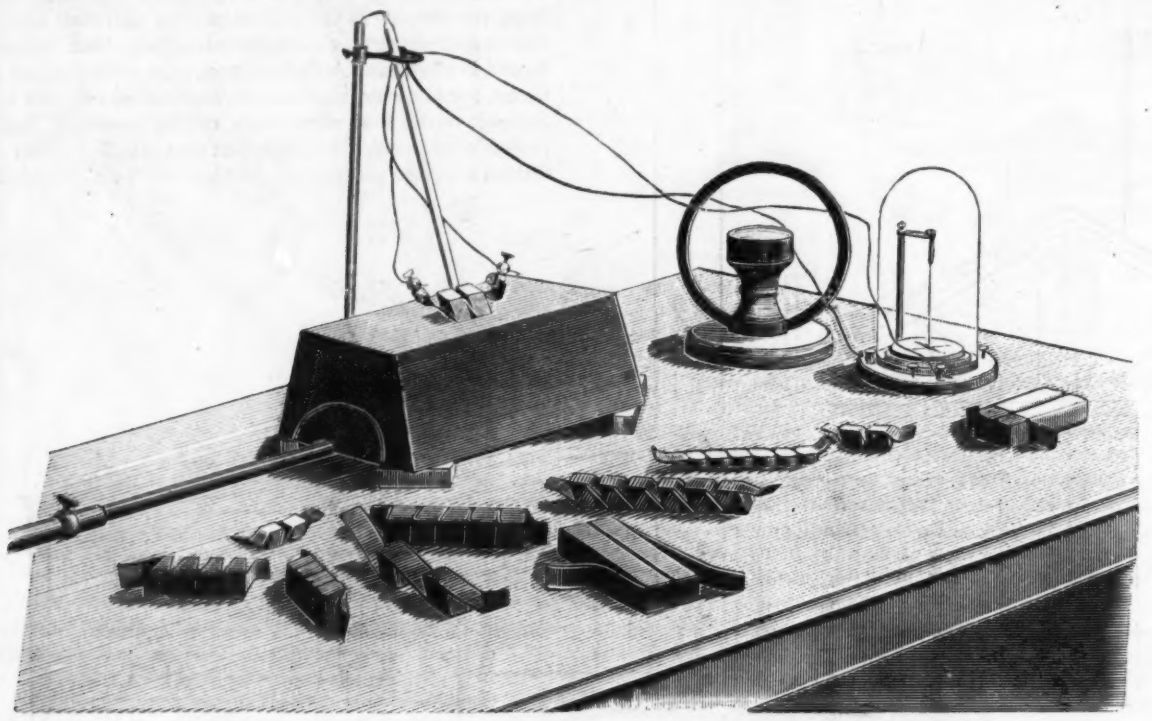


FIG. 1.—APPARATUS FOR STUDYING THERMO-ELECTRICITY.

Thermo-Electricity Theoretically and Practically Considered.—I.

BY ARTHUR RUST.

In studying electricity, one of the first thoughts to occur is concerning its nature—What is it? So simple, so easily excited, yet so subtle as to evade our keenest analysis, of what does it consist? Few have attempted to answer the question. Few have ventured to formulate any theory—they merely point to its various laws.

There is a wide divergence between the ideas which, at different periods, have obtained concerning this mighty force. The wondering, awe-struck ancients spoke of "Jove's thunderbolts hurled from Olympus;" then, generations which followed, of "the attractive property amber acquires when rubbed;" and now, the more scientific moderns have had the later conception of "the two electric fluids;" but, by common consent, no satisfactory definition has yet been established.

Turning various facts over in my mind during the years 1884 and 1885, at the end of 1885 I wrote this as a theory: "*Electricity is a mode of motion produced by friction of molecules against each other, and conveyed away by the best conductor.*"

Further researches have enabled me to extend this formula; and I now offer the following as more complete: *Electricity is one of the effects of the interaction of atoms and molecules in virtue of their physical properties.* Just as heat is now known as a mode of motion, and is produced by the friction of matter, we might similarly say that: *Electricity is a mode of motion, a flow of molecular vibrations produced by the friction of molecules against molecules (which by various methods have been brought into different conditions), and conveyed away by the best conductor.*

Of all the various sources of electricity which one can take to prove this theory, and learn to its fullest, even if only to a small extent its nature, which will answer our purpose best? After carefully thinking over the various sources, whether friction machines, voltaic cells, dynamos, percussion, vibration, disruption, cleavage, crystallization, solidification, combustion, evaporation, atmospheric in all of its varieties, pyro, animal, vegetable or thermo-electricity—thermo-electricity for many reasons appeared the best.

To a considerable extent it was an untrodden field, and one in which there was more promise of fresh facts than in any of the others. This and other things decided its selection. Accordingly, during 1886 and part of 1887, having time at my disposal, I was able to test what I have now advanced.

Most substances have a proportionate conductive energy for heat and electricity. For heat the conduction is slow, while for electricity it is all but instantaneous. The relation between the two appears to be that electricity in its transmission always generates heat, and that heat, whenever it crosses two molecules in dissimilar conditions, or of *dissimilar* specific properties, generates an electric current.

Without passing in review the various metals which have been tabulated by different writers as to their electro-motive force, and the various forms of thermo-batteries and thermo-couples that have been used, tried, or experimented with, and are a matter of history, I may just say that the experiments that are here selected for description have all been made with soft iron for the first element and zinc-antimony for the second. Many other metals and different substances have been tried during a series of some few thousands of experiments; but to simplify the argument and to clear the ground, I shall only mention a few experiments, and confine them to these two metals which were chiefly used.

In making any desired couple, it was clearly necessary to see that the iron was clean; that exactly the same proportion of zinc and antimony were used and cast, as nearly as possible, under the same conditions; that a perfect joint was made in casting, so that the iron and zinc-antimony were one body. Otherwise many false results would have been registered; and I may mention that all the results described have been tested at least four, and the majority more than a dozen, times.

Before we can expect to test any conclusion in this matter, we must quote several experiments that have been made, and in about the same order in which they actually took place. Without this it will be impossible either to explain or understand what actions really go on, though ultimately these will lead up to, and throw some light upon, the point we are trying to prove.

In testing the thermo-couples we used a Bunsen gas-burner to produce the heat, and a piece of sheet-iron of convenient shape, resting upon non-conducting supports, to supply the heat to the couples, the usual wires being connected by binding screws to the couples or leads to the galvanometer, or to the tangent galvanometer, and a thermometer to test the degree of heat, Fig. 1.

We may take the conductivity of silver at 100; that of soft iron at 20.18, and that of cast zinc-antimony at about 5.5.

We will mention three distinct forms of couples which will help us to understand the subject.

1. Cut out an angle piece from a sheet of No. 20 gauge sheet iron, Fig. 2, say 2½ inches high, by 3½ to 4 inches long, and $\frac{3}{16}$ to ¼ inch wide. Take the bottom end and twist it into a coil, Fig. 3; pour the zinc-antimony into it, and you have the two metals in combination.

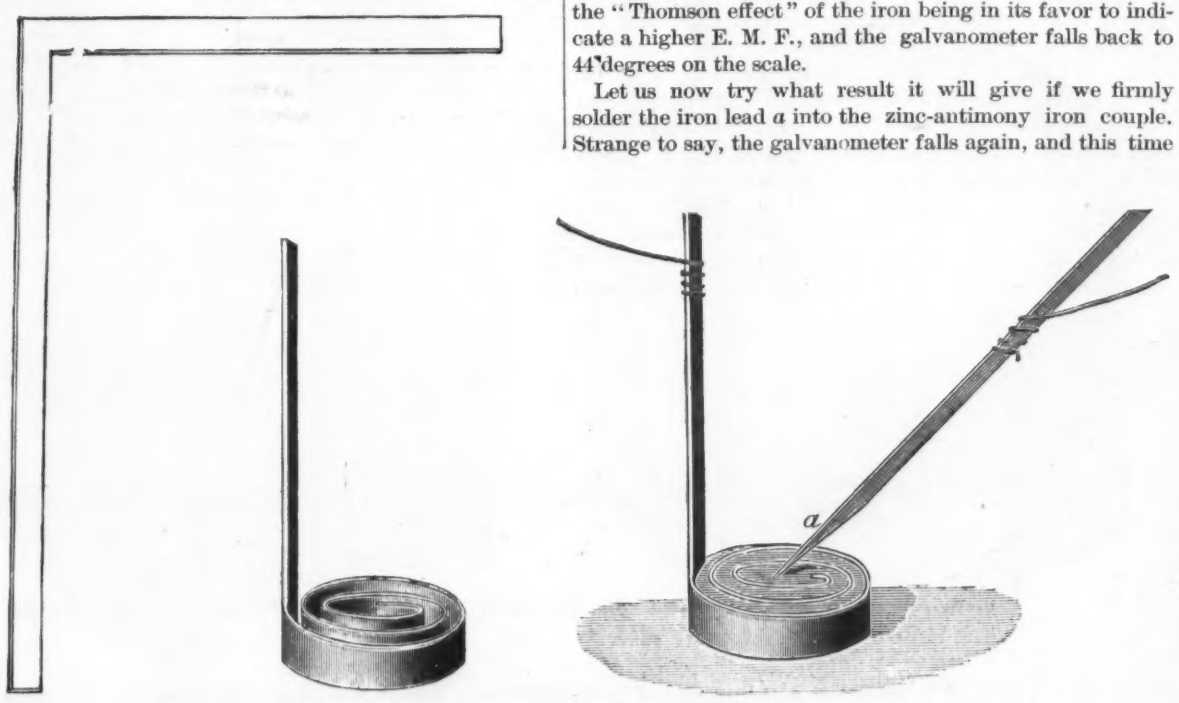
If an iron strip, thin pointed, can be cast into the zinc-antimony slightly, so that it balances itself, it makes the experiment easier. Connect the two ends up, raise the heating surface to about 375 degrees F., and the galvanometer will give, say, 50 degrees deflec., Fig. 4. Have a pot of melted wax at the same temperature ready at hand, and plunge the thermo-couple into it. No E. M. F. is indicated, and at once the galvanometer falls to zero.

Take three of these and join them together by a copper wire lead just touching the centre of the next couple, Fig. 5; the galvanometer registers 70 degrees.

Now take three others, cast firmly, and connected together in casting, as in Fig. 6, and at 375 degrees F., what is the result? Is it 70° deflection? No, galvanometer zero!

Take couple, Fig. 4, again, with different temperatures; 300 degrees F. shows 40 degrees deflection; 375 degrees F. shows 50 degrees deflection; but strange to say, if carried up to 400 degrees F., in spite of Sir W. Thomson, or the "Thomson effect" of the iron being in its favor to indicate a higher E. M. F., and the galvanometer falls back to 44 degrees on the scale.

Let us now try what result it will give if we firmly solder the iron lead *a* into the zinc-antimony iron couple. Strange to say, the galvanometer falls again, and this time it is at zero instead of at 50 degrees. Why is this? What is the meaning of it?

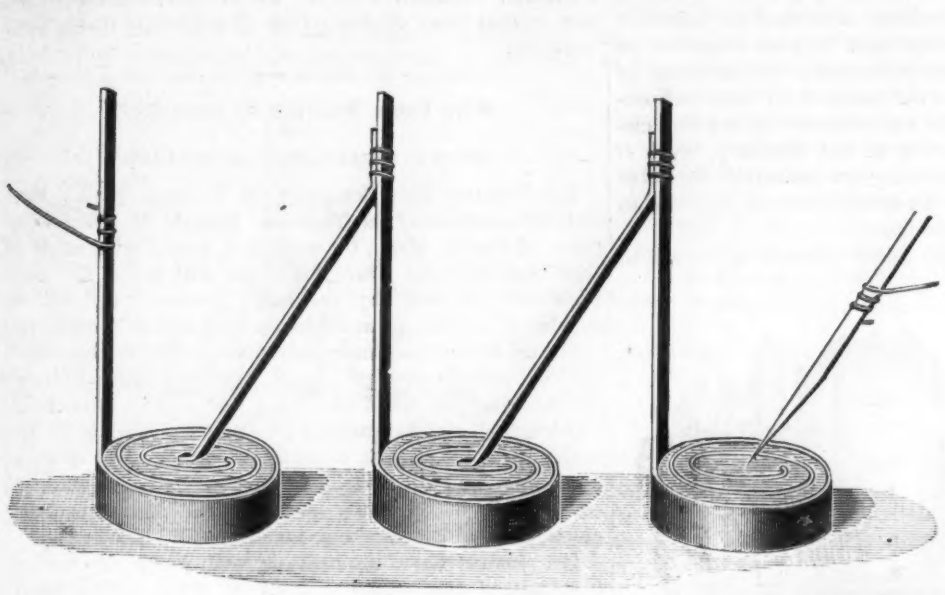


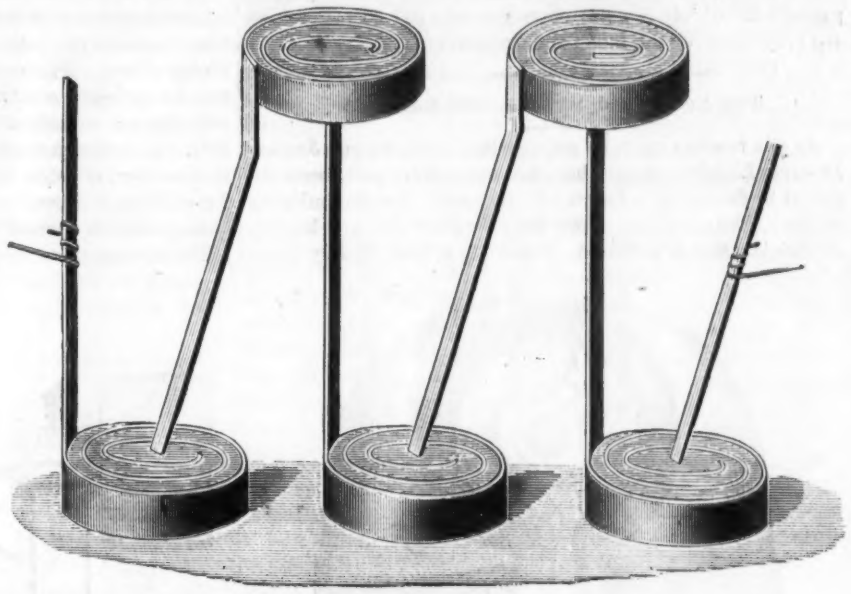
FIGS. 2, 3 AND 4.—NEW FORM OF THERMO-ELECTRIC COUPLE.

We now construct another of these zinc-antimony iron couples, but instead of pouring the zinc-antimony into the iron coil level, we will more than fill it with zinc-antimony, Fig. 7, and raise the temperature to about 400 degrees F. If we put the iron lead connection on to the top at *a*, galvanometer shows 46 degrees, but if we twist the copper lead firmly round the bottom of the alloy at *b*, instead of 46 degrees being indicated at the galvanometer, we cannot get more than 41-42 degrees. How is this?

Remembering that the conductivity of iron is almost four times that of Z-A, and, therefore, the more we can bring the molecules of the two metals into friction the greater E. M. F. will be obtained, let us cast a couple in the following form:

Take again a piece of No. 20 gauge sheet iron, cut it to the pattern, Fig. 8, instead of into the narrow strip; roll this into a coil as before, and we have, after casting the Z-A upon it, a couple in the form, Fig. 9. Lay the copper lead (*a*) firmly on, and we have as a result about 40 degrees deflection—not equal to Fig. 4. Now to understand the





FIGS. 5 AND 6.—VARIOUS FORMS OF THERMO-ELECTRIC COUPLES.

reason of this, we must seek an explanation in some other direction.

Before turning to some older forms of thermo-couples, let us mention a few results from others, which we will call Class 2.

Take some iron rings $\frac{5}{8}$ inch in diameter and $\frac{11}{32}$ inch deep, Fig. 10; cast two copper leads into the alloy when casting

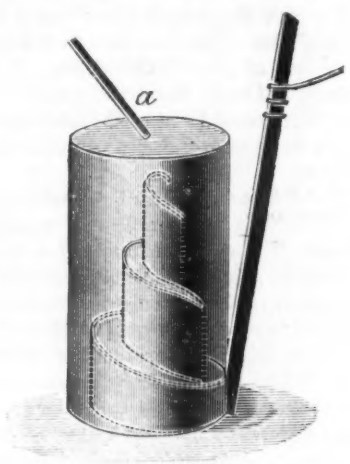


FIG. 9.—THERMO-ELECTRIC COUPLE.

the zinc-antimony into the rings. At 350 degrees F. it shows 15 degrees defl., and at 400 degrees F., 25 degrees defl. Again with similar rings cast two German silver leads into the alloy: at 350 degrees F. it shows 1 degree defl.; and at 410 degrees F., 1 degree defl. the same. But if one German silver lead and one copper lead is used, at 410 degrees F. it shows 42 degrees defl. Construct three of these rings, fasten their leads firmly together, German silver to copper; at 330 degrees F. we get 50 degrees defl., and at 410 degrees F., 60 degrees defl.

Again, let us take a piece of No. 20 gauge sheet iron, like Fig. 2, but cut the foot longer, and instead of turning it into a coil, turn it into a square, Fig. 11, lay a copper lead on at *a*, and you cannot get more than 40 to 45 degrees indicated upon the galvanometer. Lay a second lead in connection with the first one at *b*, and you obtain 49 degrees on the galvanometer. Lay a third one, also in connection, on at *c*, and 54 degrees is the result.

On an Experimental Theory of the Lead Accumulator.

BY LEONARD PAGET, PH.D.

M. Gaston Roux, the well-known French electrician, has very recently completed a series of researches in M. Hospitalier's laboratory, at the Industrial Chemical and Physical Schools of Paris, on the much vexed question of the chemical reactions occurring in the lead storage battery.

There are two accepted theories. One supposes that during the discharge the negative electrode is alone sulphated, and that the peroxidized plate is partially reduced. The second, on the contrary, admits that both electrodes are sulphated; and this is probably the more nearly true. In support of this theory M. Roux determines the quantity of acid absorbed by each electrode during the discharge and the corresponding number of ampère hours. The quantity of acid engaged in a reaction was obtained from the difference between the quantities before, and after, the reaction. The amount of acid was calculated from the volume of a very dilute solution of potash required to saturate 25 cubic centimeters of the acid solution. The solution of potash was titrated frequently with a normal pure sulphuric acid solution. Very simple calculation deduced, from the number *n* of cubic centimetres of potash required to saturate 25 cubic centimeters of acid solution, the weight of normal sulphuric acid (H_2SO_4) contained in a given volume of liquid.

The experiments were carried out on three plates of Julien battery, tramcar type; one negative and two positive plates in excellent condition. The negative plate was put into a flat porous vase, holding about 750 c.c. liquid, and the two positive plates externally to this porous cup in a glass vase containing 1,500 c.c. of solution. The plates, after gently charging until gas was abundantly given off, were left 24 hours on open circuit; and then were introduced into the two vases, filled to the same height with acidulated water of 1.17 density. The accumulator was then discharged, the discharge being measured and stopped when the difference of potential commenced to fall. From a large number of experiments there resulted the following figures:

WEIGHT OF NORMAL SULPHURIC ACID ABSORBED PER AMPERE HOUR.		
By the negative plate	By the positive plate.	By both plates.
1.410 grms.	2.293 grms.	3.703 grms.

Numerous experiments made with the same plates in a porous vase showed that the total weight was always a little less than 3.70 grms.; nevertheless, this figure was adopted in subsequent calculations. If we take for the electro-chemical equivalent of sulphuric acid the figure 0.51 (Reynier), which corresponds to 1.838 grms. of acid per ampère hour, we perceive that there will be two molecules ($2 \times 1.838 = 3.676$) of acid engaged per ampère hour.

This consideration leads to the admission that each of the two plates absorbs 1 molecule of acid in order to transform itself into sulphate. But, in fact, on the 3.70 grms. included in the reaction, there are 1.41 grms. absorbed by the negative plate and 2.29 by the positive plate, which leads to the following formula for the products formed during the discharge:

Negative.	Positive.
$Pb_4(SO_4)_3$	$Pb_4(SO_4)_5$

And these formulæ are satisfied by the equations:

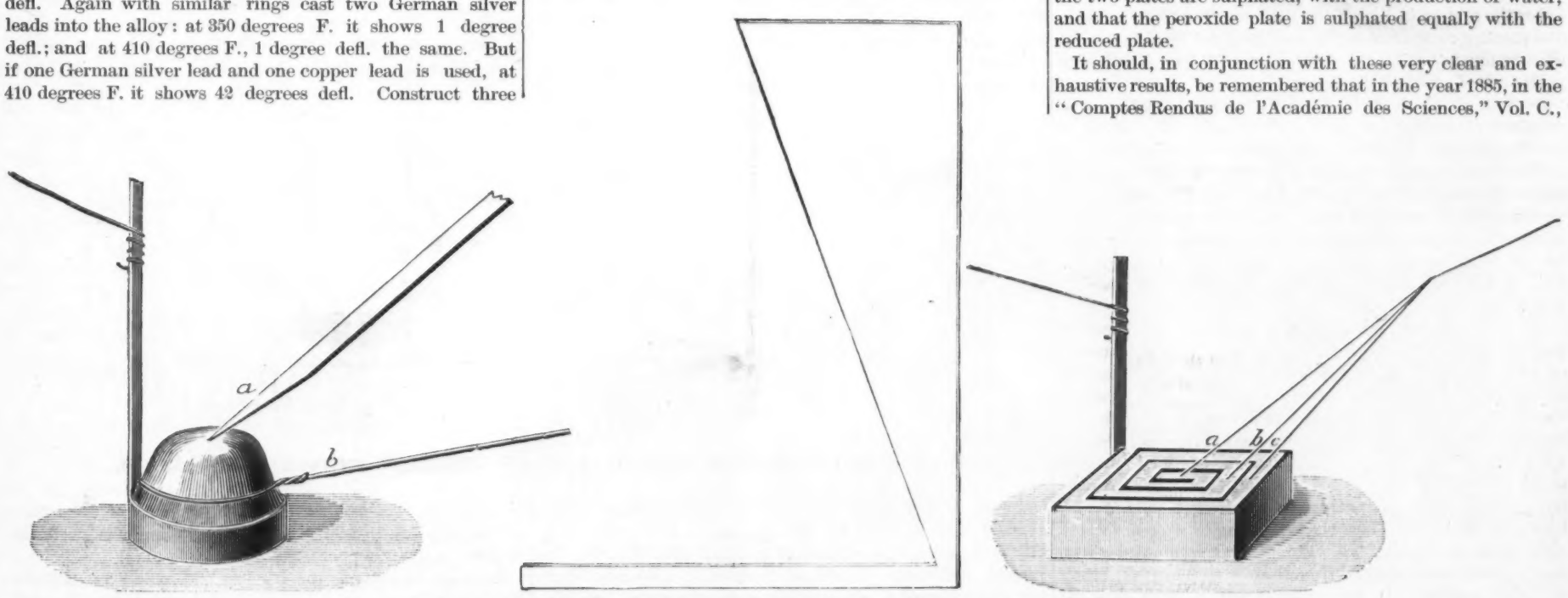
Before the discharge: $4(PbO_2) + 5(SO_4H_2) + 3(SO_4H_2) + 4\,Pb =$

After the discharge: $Pb_4(SO_4)_5 + Pb_4(SO_4)_3 + 8\,H_2O$.

FIG. 10.—THERMO-ELECTRIC COUPLE.

These experiments, then, prove that during the discharge the two plates are sulphated, with the production of water, and that the peroxide plate is sulphated equally with the reduced plate.

It should, in conjunction with these very clear and exhaustive results, be remembered that in the year 1885, in the "Comptes Rendus de l'Académie des Sciences," Vol. C., pp. 1458–60, M. Tscheltzow showed that thermo-chemical data required sulphating of both electrodes to fully account for the observed electromotive force of a lead accumulator. The heat of formation of peroxide of lead permits of the examination of the chemical reactions occurring on the two plates of an accumulator. There were four hypotheses examined by Mr. Tscheltzow, and it may be that these were unknown to M. Roux, else it is probable he would have deduced the results obtainable from "heat of formation" in proof of his own results. These hypotheses are: If PbO_2 were reduced to Pb by the hydrogen at the nega-

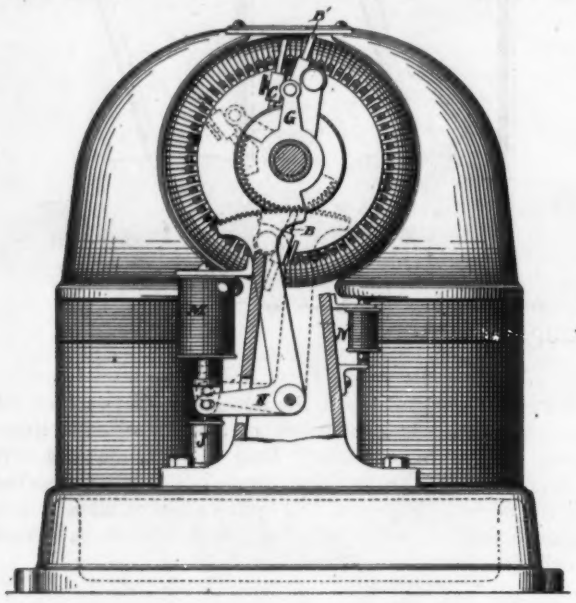


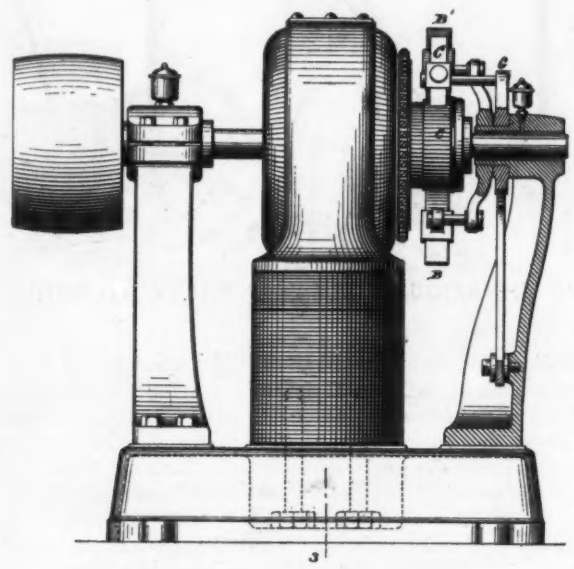
FIGS. 7, 8 AND 11.—VARIOUS FORMS OF THERMO-ELECTRIC COUPLES.

tive pole, the reaction would disengage 37.20 calories, corresponding to 0.81 volt. If PbO_2 were transformed into $PbSO_4$, the disengagement of heat would be 81.50 calories, corresponding to 1.77 volt. If the negative lead were transformed into sulphate, and PbO_2 into Pb, there would be disengaged 44.30 calories, corresponding to 0.96 volt. If there were sulphating of the two electrodes, the heat disengaged will be 81.60 calories, corresponding to 1.93 volt, which we may consider the true fundamental reaction.

The New Wood Dynamo and Regulator.

As our readers may be aware, the Fort Wayne Jenney Electric Light Company has, for some time past, been engaged in fitting up a factory in Brooklyn for the building of arc light apparatus, under the charge of the well-known electrician Mr. J. J. Wood. This shop is now rapidly near-





FIGS. 1 AND 2.—THE NEW WOOD ARC LIGHT DYNAMO.

ing completion, and soon will be capable of turning out apparatus for several hundred arc lamps per week complete. While Mr. Wood will continue the construction of his well-known machine of the Gramme type, he will also undertake the building of a modified form employing the Gramme ring, the machine being shown in end view and in elevation in Figs. 1 and 2.

In this new type of machine Mr. Wood makes use of a new principle of regulation through the medium of the shifting of the brush on the commutator. For this purpose he winds the field magnets with two coils, the main exciting coil, connected in series, and the supplementary demagnetizing coil inversely connected in a shunt. The reverse current through this shifting coil is a continuous current, which follows continuously during the normal running of the dynamo, and is increased or decreased by the action of an automatic regulator responding to changes in the main or external circuit, and proportionately varying the E. M. F. of the current in the shunt coil, so that it reduces the magnetization of the field magnet more or less, and thereby compensates for any increase or decrease of current due to variations of resistance in the circuit or to variations of speed of the dynamo.

In order clearly to understand the action by which this regulation is brought about, we would refer our readers to the diagram Fig. 3. Here is shown the commutator *A*, of a Gramme armature, and *B B′*, the positive and negative main collecting brushes, arranged to touch the commutator on the neutral line *x x* or in the position of maximum current. The main exciting coil of the field-magnet *D* is connected in series with the line between the brushes *B B′*. This is the ordinary arrangement for self-excited series-wound dynamos.

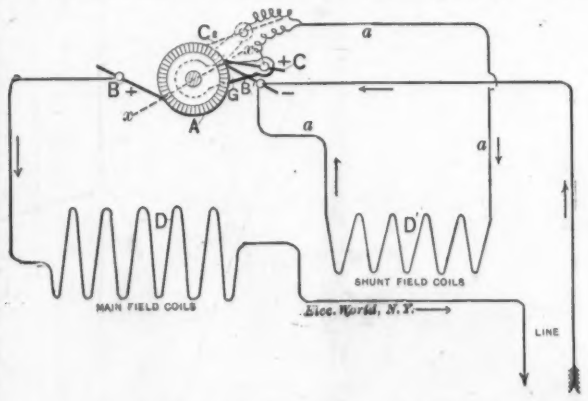
An auxiliary commutator brush *C* touches the commutator *A* adjacent to the negative brush *B′*, and is mounted on an arm or yoke *G*, by the movement of which it can be shifted around the commutator. A shunt coil, *D′*, has its terminals connected by shunt circuit wires *a a* with the auxiliary brush *C* and the negative main brush *B′*. When the brush *C* is in contact with the brush *B′*, it is obvious that both will have the same potential, and consequently no current will flow through the shunt *a D′*. If, however, the brush *C* be advanced along the commutator away from the brush *B′*, it will rest upon commutator-segments of different potential from those with which the brush *B′* makes contact. As the brush *C* will, in such case, be nearer the positive side of the commutator than the negative brush *B′*, it will exhibit relatively to the latter a positive potential, and a current proportional to the difference of potential will flow from the brush *C* through the shunt circuit to the brush *B′*. The quantity of current thus flowing through the shunt-circuit will vary according as the brush *C* is moved away from, or toward, the brush *B′*. The position shown in dotted lines at *C′* may be assumed to be the limit of movement of the brush *C* away from the brush *B′*, so that when the brush is in this position the current in the coil *D′* will be at its maximum.

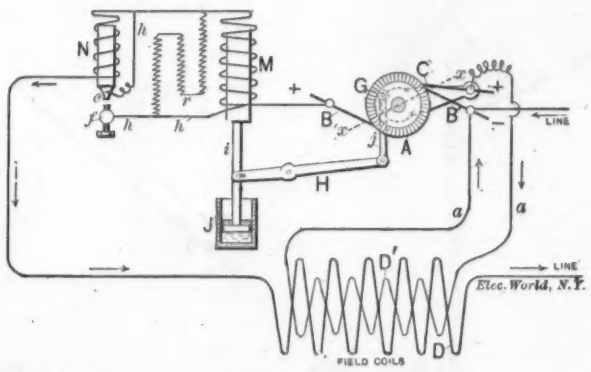
If now we imagine the shunt-coil *D′* wound upon the field-magnet along with the main coil *D*, but connected inversely thereto, it will be apparent that the current in the shunt-coil will act to neutralize more or less the current in the main coil, and consequently to reduce the magnetization of the field; and the magnetization will be more or less reduced according as the current in the shunt-coil is increased or diminished.

We have here all the conditions for a perfect regulation of the dynamo. If an attendant watching an ammeter were to move the yoke *G* from time to time whenever he observed any variation in the indication of the ammeter, he could regulate the output of the machine so as to compensate for any variations in the resistance on the external circuit. A more perfect control of the auxiliary brush *C* is, however, effected by providing an automatic regulator for shifting this brush over the commutator in response to changes in the current on the line.

The arrangement by which this is effected is shown in the engraving Fig. 2, and the diagram Fig. 4 shows its operation in detail. A regulating electro-magnet or solenoid *M* has its coil connected in the main circuit in series, with a shunt *h h* around it, by which it may be short-circuited. A relay magnet *N* is connected in the main circuit exterior to this shunt, and serves by the attraction of its armature to break the shunt circuit *h*. The magnet *N* is a solenoid, the core of which carries a contact *e*, which touches a contact-screw *f*, both in the shunt circuit *h*. To prevent sparking between the contacts *e f*, a resistance *r* is connected between these contacts across the shunt *h*, and short-circuiting the coil of the solenoid *M*. The core *m* of this solenoid is connected to the auxiliary brush *C* by a bent lever *H*, so that by its movement this brush is correspondingly moved, a dash-pot *J* being provided to prevent too sudden movements.

When the machine is running under maximum load, that is, with all the lamps in the circuit lighted, the brush *C* stands almost or quite in contact with the brush *B′*, so that the current through the main field coil *D* is not neutralized (or not to any appreciable extent) by a counter-current in the coil *D′*; hence the field-magnet is excited to the normal extent and the machine is generating the normal





FIGS. 3 AND 4.—WOOD'S NEW METHOD OF CONSTANT CURRENT REGULATION.

current. If now one or more of the arc lamps are extinguished, thereby reducing the resistance and proportionally augmenting the volume of current, the relay *N* is excited sufficiently to attract its core, and thereby break the shunt circuit *h*, whereupon nearly the entire current, which until this instant has flowed in large part through the shunt *h*, thereby avoiding the solenoid *M*, is directed through this solenoid, strongly exciting it and causing it to draw up its armature *m* at as rapid a rate as the dash-pot *J* will permit, and thereby moving the auxiliary brush *C* around the commutator away from the brush *B′*. There results from this an increased current through the shunt-coil *D′*, which neutralizes proportionally the magnetizing effect of the main coil *D*, and reduces the magnetism of the field, thereby diminishiug the current generated and restoring an equilibrium in the external circuit.

In practice the regulator effects an intermittent rise and fall of the current, due to the relay *N* shunting almost the entire current through the solenoid *M* whenever its excitation rises above the normal, and then, when the regulator has responded to the consequent increased excitation of the solenoid *M*, and reduced the current to the relay *N*, shunting the greater part of the current around the solenoid *M*, and thereby disproportionately reducing the excitation of the latter, which gives rise to the contrary regulating action, so that these effects follow alternately at momentary intervals.

Wire Cable Welding by Electricity.

BY O. K. STUART AND A. M. BULLARD.

The Trenton Iron Company, of Trenton, N. J., have ordered machines of the Thomson Electric Welding Company, of Boston, Mass., for welding a special wire cable of their manufacture. These machines will be of the most improved type built by the latter company, and will be capable of welding these cables up to 1¼ inches in diameter.

The cable is of peculiar construction and is distinguished by high tensile strength, great flexibility and admirable wearing qualities, all of which are due to the remarkable construction, and the quality of the material used in it. The cables are made of hard drawn, low carbon steel of great uniformity, and are of various diameters, but all constructed substantially in the same manner. The diameter of the pieces upon which tests were made was .908 inch.

The construction of the cable is well worth description. It consists of four successive layers of wires, with a single round wire for a core. Looked at endwise, it shows four concentric rings of different thicknesses, with a fine single wire core. The first or outside layer or ring is made up of 24 wires, cold drawn, and each wire fitting neatly and locking with the next adjacent. The next layer or ring consists of 19 wires, which, when laid up against each other, make a complete circle, whose outside circumference is equal to the inside circumference of the first layer. The third layer is made up of 12 round wires, the area of the cross section of each of which is larger than that of any of the wires of which the last or fourth layer is composed, these being round also. The core is round wire, as stated above, and is as fine as any of the others. Each layer of wire has a direction of twist along the length of the cable, opposite to the direction of twist of the next layer or layers, and the angle of twist of each layer is different from that of any other layer.

We have entered into these details minutely in order that the difficulties of solving the problem of welding the cable may be apparent. The solution involved unusual preparation of the ends to be joined, the employment of special devices, and more than ordinary care in the operation of the welding apparatus; and it was only after considerable experimenting under the direction of Prof. Elihu Thomson had been done that the satisfactory results mentioned in the latter part of this article could be secured.

The following absolute conditions had to be met:

1. It was necessary to provide means for preventing the individual wires from fraying outward when the endwise pressure used in the welding was applied. 2. It was necessary that the cable be gripped in such a manner as to prevent sliding movements of the wires with relation to each other. 3. An unusual preparation of the ends had to be made in order to accomplish, at least approximately, the individual welding of the wires composing the cable, so that in bending around a sheave the load strains might be distributed at this point in the same manner as at any other point. 4. It was necessary to have the ends of the wires at one terminal as nearly as possible in line with the ends of those in the other terminal.

In order to prevent the fraying and expanding actions above mentioned, it is found necessary to shrink mild steel or iron sleeves or collars tightly upon the cable close to the ends (about $\frac{1}{16}$ inch therefrom); and this arrangement is found effective in preventing the wires from sliding over each other when the pressure is applied in welding; but it also prevents the separate welding of the individual wires forming the cable, a difficulty overcome by special preparation of the ends of the cable, viz., by cutting grooves between the ends of the contiguous layers of wires, forming thereby a series of concentric circular grooves. This permits of a definite amount of "upset" of softened metal at the end of each wire, which must be allowed for, it being caused by the endwise pressure used in forcing the pieces together when the welding temperature is reached; and

permitting also, therefore, the welding of the individual wires forming the cable. The ends of the separate wires can be brought exactly opposite each other by the exercise of ordinary care upon the part of the operator of the machine; and with these preparatory arrangements made, the joining of the cable is a problem in plain butt welding by electricity.

The great and peculiar strains to which cables are frequently subjected make it necessary that they possess high elastic limit and tensile strength, combined with extreme flexibility, and any method of joining cables which destroys these qualities would be useless as applied to such work. In experimenting, therefore, it was a matter of the first importance to determine the tensile strength and breaking loads of all welds made, and this was done either on a Riehlé 100,000 pounds testing machine in the factory of the Thomson Electric Welding Company at Lynn, or under the supervision of the United States Government on the Emery machine at the Watertown Arsenal.

The material of which the wires forming the cable are composed being of steel, it is obvious that heat will anneal it if allowed to cool slowly, and it was necessary consequently to determine the respective tensile strengths of the unannealed and annealed cable. Tests made at the Watertown Arsenal with hydraulic clamps show the cable to have a maximum tensile strength of about 67,700 pounds per square inch, and this strength drops to about 50,500 pounds when the metal is annealed by heating to a temperature slightly below that of welding, and allowing it to cool slowly.

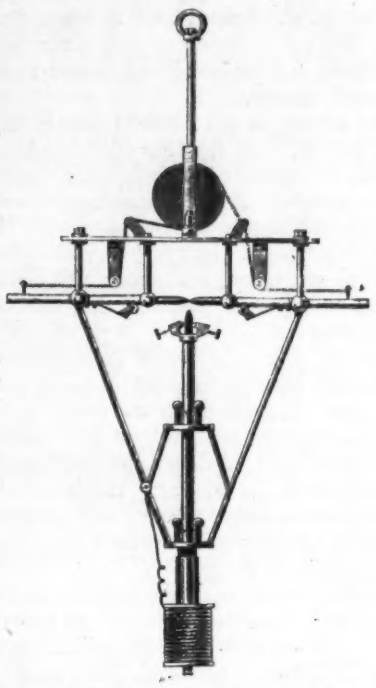
If, therefore, welds are made which will stand a maximum load of 50,000 pounds or over, a practically perfect result will be obtained, provided elasticity and flexibility are not destroyed.

The tensile tests of the welded cable give the most perfect results, the maximum tensile strength of the welded specimens averaging over 50,000 pounds, some specimens resisting strains as high as 53,000 and 54,000 pounds per square inch, which is over 80 per cent. of the maximum load stood by the unannealed cable.

Although it was found to be extremely difficult to obtain accurately the elastic limit, either in the unwelded or the welded specimens, yet the indications are that the ratio of elastic limit to maximum load in unwelded specimens is about that of the welded specimens.

Severe bending and twisting tests give similarly good results, the cable resisting bending back and forth many times over an angle of 180 degrees at the weld. In such cases the fractures are always irregular and away from the weld, and present a gray, fine granular appearance, all of which proves that the condition of the cable at the weld is approximately what it was originally.

The value of the electric process as applied to such work will be appreciated when it is considered that, notwithstanding the difficulties encountered and the fact that groups of wires and not solid metal were united, over 80 per cent. of the normal strength is obtained in the electric weld, rendering it practicable to use it for many purposes heretofore deemed impossible.



THE CHAPMAN AND DEARING ARC LAMP.

Chapman and Dearing's Arc Lamp.

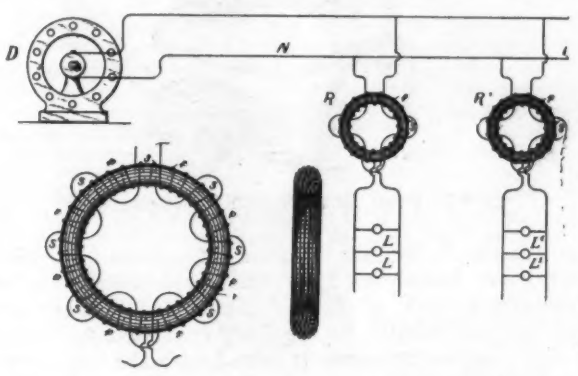
The accompanying engraving, taken from the London *Electrical Review*, illustrates a new arc lamp, for which a number of advantages are claimed by the inventor.

In this lamp there are two positive carbons, which are placed horizontally, meeting in the centre, and the single negative carbon is placed at right angles to these. The lower part of the frame is insulated from the horizontal guiding tubes, and the top plate and the two portions of the positive carbons are fed together by the action of a spring, coiled in a drum, and are always kept in contact.

The negative carbon is fed by the pressure of a spring inside the holding tube pressing the carbon against the abutments near its point, or it may be fed by any suitable clutch arrangement. It is kept in contact with the positive carbons by means of a light spring, until the passage of the current, which enters by the binding screws, through the standards to the positive carbons, through the negative, and around the solenoid, thus acting on an iron core attached to the vertical tube, and so striking the arc.

By placing the lamp in a certain position, the inventors claim that they are enabled to light the centre space between two lamps effectively, as the light is distributed horizontally, and is well diffused. This allows of placing lamps at a less height than the ordinary vertical carbon lamps, and, by reason of the arc always remaining in a fixed position at the top of the lantern, no heavy shadows are produced, as the carbons burn down low, and the lamps can, of course, be made to run any reasonable time with one set of carbons.

The lamp is also well adapted for a focussing search light, and by its construction is claimed to be able to take heavy currents without danger of the carbons splitting by overheating.



RANKIN KENNEDY'S TRANSFORMER SYSTEM.

More Alternating Current Litigation.

A press dispatch dated Pittsburgh, July 17, announces that the Westinghouse Electric Company intends shortly to enter suit against all other companies operating alternating systems in this country, on the strength of a patent just granted to Mr. Rankin Kennedy, of Glasgow, Scotland, and assigned to the Westinghouse Company. Mr. Kennedy's work on alternating currents is well known, and, in view of the above, our readers may be interested in the patent just issued to Mr. Kennedy, which is claimed to cover the essential features of the present systems employing alternating currents.

After referring to the difficulties experienced in operating transformers connected in series with the generator, Mr. Kennedy's patent describes the multiple arc method of connection, as illustrated in the accompanying drawings, and explains the actions which take place when transformers are connected in this manner, each being thus made independent of the other, and each being self-regulating. The following is the claim of the patent:

"The method of distributing and regulating alternating electric currents by secondary generators, which consists in producing in two or more derived circuits constituting the primaries of two or more secondary generators a counter electro-motive force which, when any secondary is open, is practically equal to the applied electromotive force in its primary, and in controlling said electromotive force by the current flowing in the corresponding secondary, when the secondary is closed, in such manner that the current in the primary shall vary with and be approximately inversely proportional to the resistance in the secondary, substantially as described."

Reviving Exhausted Dry Primary Batteries.

BY CH. J. MILLER.

In the ELECTRICAL WORLD of July 20 there appears an inquiry by "X," as to the possibility of reviving dry primary batteries by recharging from gravity cells. In answer to this I would say that I have very successfully recharged dry batteries, among others, the Gassner, which was found to become very strong, almost regaining its original strength after a charge of 3 to 4 hours, when connected backwards, or as if opposing, 10 gravity cells in series. With 10 gravity cells it is easy to recharge a number of dry cells connected in multiple across its terminals. The writer hopes that this information may be of use to "X," as well as to others using dry batteries.

Automatic Accumulator Station in France.

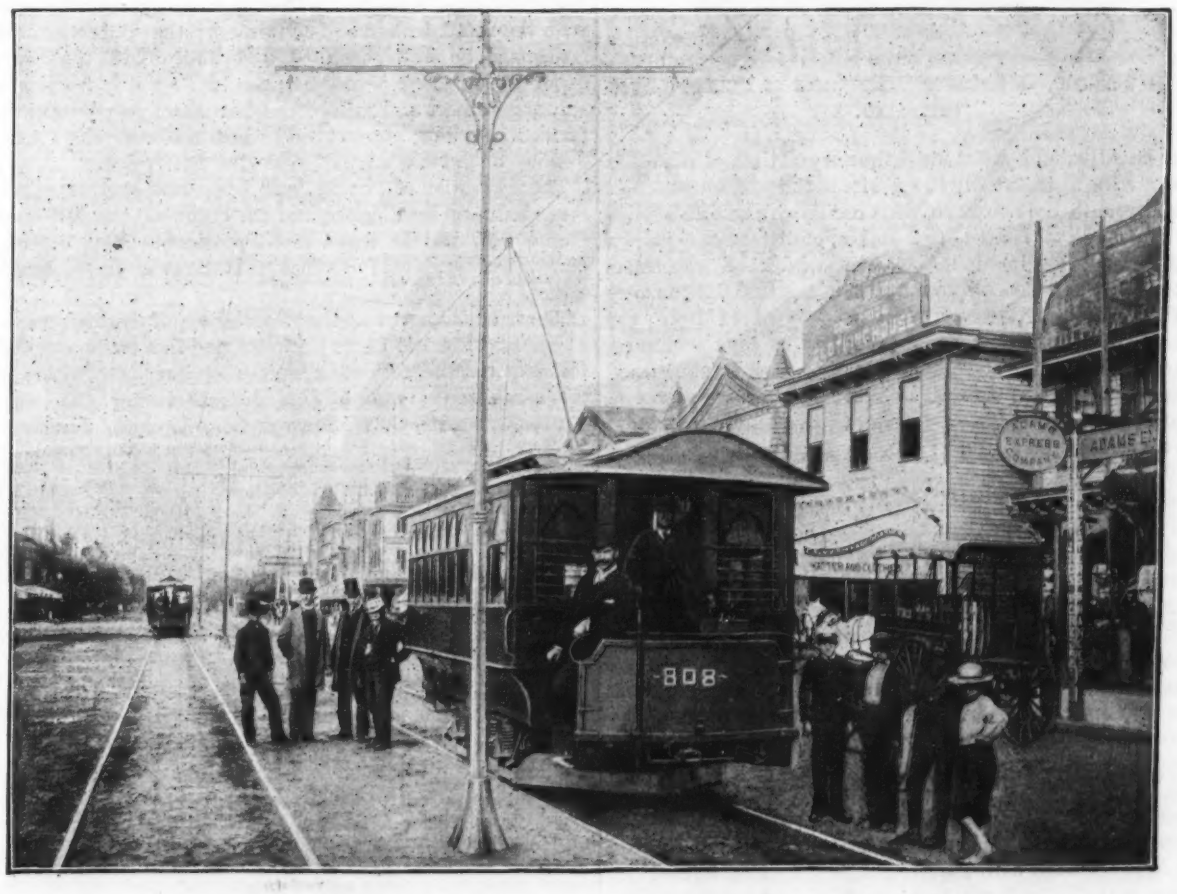
Electric lighting has been recently introduced into the town of Saint-Hilaire du Harcouet, on the coast of France. The station is situated at Varoux, some three miles off, in order to utilize a waterfall for the motive power. Two coupled turbines are used, which run a Thury dynamo, giving 600 volts and 17 ampères. Sets of accumulators are placed at the four corners of the town, and are charged for a period of 16 hours. At night every one goes to bed at the station, and the lighting and extinction of the public lamps is effected by the mayor's clock, which is arranged to connect and cut off the current at certain hours. A similar system was adopted at St. Etienne in 1883, where a waterfall at Furens was utilized.

Sprague Electric Railway to Atlantic City, N. J.

We present in this issue a recent view, taken from a photograph, of one of the electric cars in operation upon the Atlantic City Electric Railway. This engraving shows very clearly the overhead construction, and the style of double bracket iron poles which are used upon this railway.

This is one of the more recent of the Sprague installations, and we understand that its operation has been very successful and highly satisfactory to the Pennsylvania Railroad Company, which owns the system of street railways at Atlantic City.

Since its installation, this railway has carried a large number of passengers, and the cars are often obliged to carry 100 or more passengers each, making 200 passengers drawn by two 15 h. p. motors which propel the motor car. In spite of these loads, which fill the cars, especially in the afternoon, the electric cars in operation upon this railway have not missed a single schedule trip, notwithstanding the fact that all the motors operated by this line are in constant use, and there are no reserve cars at Atlantic City.



VIEW OF SPRAGUE ELECTRIC RAILWAY, ATLANTIC CITY, N. J.

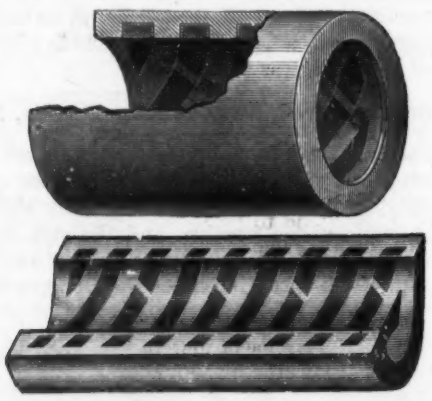
A Galvani Manuscript.

A manuscript belonging to Galvani has, it seems, been found in the Communal Library at Bologna, though it is not the manuscript of an unknown treatise by the great savant, the work to which it belongs being "De Viribus Electricitatis in Motu Musculari," which was published about the year 1792. The discovery is, however, of considerable historic interest on account of the large number of marginal notes in Galvani's own handwriting which this treasure-trove contains.

Studying Alternating Currents by Means of Vibrating Strings.

In a paper appearing in the *Journal* of the London Institution of Electrical Engineers, Part 79, Vol. XVIII., entitled "Laboratory Notes on Alternating-Current Circuits," Profs. Ayrton and Perry refer to the following interesting method of studying the varying phases of alternating currents:

Quite recently two of our students—Messrs. Healing and Le Tall—have been experimenting on another resonance method of analyzing an alternate-current vibration which we have suggested to them, and, considering how rough is the apparatus they have been using, and how short a time they have been engaged on this new method, the results are unexpectedly satisfactory, and appear to show that this method, which is extremely simple, is one of great promise. The alternate current to be analyzed is passed through a stretched wire, *V V*, of the accompanying diagram, the length or tension of which can be varied as in a monochord. This wire is in a magnetic field produced by a permanent magnet, *N S*, or by an electro-magnet, or, best of all, by a coil of wire surrounding the wire *V V*, as a flat galvanometer coil surrounds the needle. As the current in the wire alternates, the wire receives impulses backward and forward across the lines of force produced by the magnetic field, and if the length and tension of the



Figs. 1 and 2.—Graphite Bearings for Pulleys and Shafting.

wire be adjusted by trial until the natural time of vibration of the wire agrees with the periodic time of variation of the alternate current, the wire oscillates vigorously with an amplitude of from 1¼ to 2 inches, emitting, of course, a musical note. The sudden way in which the wire starts vibrating when its length and tension are just right is very striking. The frequency can be determined from the musical note emitted by the wire; but as that would require tuning-forks or some other apparatus having fixed rates of vibration, as well as a musical ear, we prefer to determine the frequency by using the well-known formula for a vibrating string, viz.:

$$n = \frac{1}{2l}\sqrt{\frac{t}{m}};$$

where n is the frequency, l the length of the wire in centimetres, t the tension in dynes, and m the mass in grammes per centimetre of the wire.

In the first experiments we commenced with the wire comparatively slack, and on gradually tightening it up it was seen to vibrate very slowly. Holding one's finger on the wire and counting the vibrations, they were found to correspond with the speed of the engine driving the alternate-current dynamo *D*, which was sending the alternate current through the wire. On tightening up the wire a little more it responded to twice this rate of vibration, which may, perhaps, have corresponded with the number of piston strokes; then the wire required a good deal of tightening, when it suddenly burst into vibration, and on calculating the value of n from the formula just given, a result was obtained closely agreeing with the electric frequency, which, with the particular dynamo employed, was eight times the number of rotations of the armature per second. On tightening the wire still more, shriller notes were heard, and smaller waves seen superadded on the fundamental vibration of the wire as a whole. We were at first afraid that the analysis of the harmonics of the alternate current would be troubled by the vibrating wire having harmonics of its own, but were reminded by Mr. Lamb of the well-known fact—which we ought to have remembered—that the harmonics possessed by the vibrating string of a musical instrument are impressed on it in the act of setting the string in vibration, or, in other words, that a string has no harmonics of its own. Hence we may safely conclude that the higher rates of vibration seen and heard with our wire are really due to harmonics in the alternate current wave itself. To determine the frequency and amplitude of each of these harmonics, the length and tension of the wire are adjusted until its natural period of vibration agrees with the particular harmonic sought for in the alternate current, and which agreement is evidenced by the wire vibrating vigorously when it is attained.

Novel Electric Push Button and "Presselle."

The accompanying engraving illustrates a novel combination, recently designed by Mr. Jas. D. Randall, of the Novelty Electric Company, of Memphis, Tenn., and

Novel Push Button and "Presselle."

manufactured by the Viaduct Manufacturing Company, of Baltimore, Md. The push button is so constructed that a double conductor flexible cord can be conveniently and quickly connected to it by a double plug, and the current carried on to the "presselle" shown in the engraving to any distance, where by a slight pressure the circuit is completed to ring a bell, drop an annunciator or operate other electrical instruments.

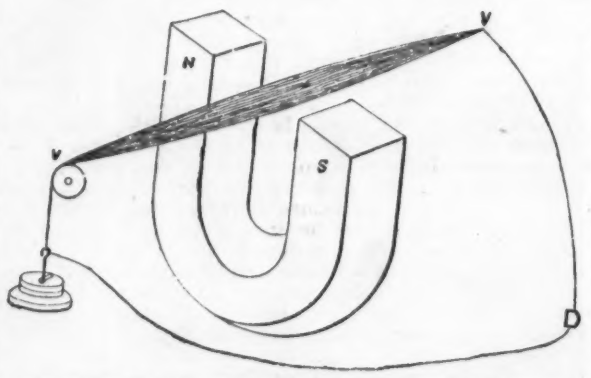
A Gas and Electric Light Fixture Trust.

Last month a meeting of the manufacturers of gas and electric light fixtures was held at the Continental Hotel, in Philadelphia, for the purpose of organizing a "trust," at which Mr. Clement M. Biddle presided.

The reason for the holding of the meetings, it is alleged, was that the business was depressed, and some of the larger manufacturing companies were not making any money. The proposed scheme to secure relief met with some opposition, it being urged, it is alleged, that it would necessitate the breaking of agreements already made by manufacturers with the retail dealers and consumers; that the retail dealers should be first consulted, and that, unless that were done, the proposed association would find it impossible to secure its object and raise, control or maintain prices in the face of a falling market, and when the materials for the making of fixtures were daily declining in price.

The opposition, however, was overcome, and an agreement has now been signed and an organization perfected. Clement M. Biddle was elected president; Silas M. Geddings, secretary, and Benjamin Hallowell, Jr., commissioner.

The trust is known as the Association of Manufacturers of Gas and Electric Light Fixtures, and in a trade circular just sent out the following names appear as members of the combination: Eagle Gas Manufacturing Company, Yeaton & Harris, G. W. Shaw & Co., Limited, Joseph S.



Effects of Alternating Currents on Vibrating Strings.

Barker, S. B. McCoy & Co., New York Gas Fixture Company, Simon Manufacturing Company, the Mitchell-Vance Company, the Shultz Art Metal Manufacturing Company, W. J. Buck, Sons & Co., Hickman Hose Coupling Company, Charles Royle, Cleveland Gas Fixture Manufacturing Company, W. C. Vosburg Manufacturing Company, Limited, Cassidy & Son, Archer & Pancoast Manufacturing Company, Oxley, Giddings & Enos, Iden & Co., Joseph Donaldson, F. McLewee & Son, Thackara Manufacturing Company, De Kosenko & Hetherington, Horn, Brannen & Forsyth Manufacturing Company, Brooklyn Gas Fixture Manufacturing Company, James I. Middleton, L. Plant & Co.

It will be noticed that the list does not include all the manufacturers of electric light fixtures, and it is stated that a number have refused to join the combination.

Graphite Bearings for Pulleys and Shafting.

The high speed usually employed in electrical machinery necessitates great care in the lubrication of the frictional surfaces, and the expense of the oil required for this purpose is quite an appreciable item in the cost of station operation. The great lubricating qualities of graphite have more than once led to its suggestion as a substitute for oil, and some years ago experiments in this direction were undertaken by the Graphite Lubricating Company, of Jersey City, N. J. These were of such a satisfactory nature that they led to the application of the material to all kinds of surfaces in frictional contact, such as the bearings of pulleys, shafting, etc.

The object aimed at has been to obtain fixity of the graphite by uniting with it other materials in a minimum and retaining the graphite in a maximum quantity. This maximum of graphite and fixedness has been obtained by the union of materials that do not appreciably diminish the lubricating properties of the graphite. The composition is not affected by oil, water, atmospheric changes, artificial heat or steam at 80 pounds pressure, and contains nothing to injure the shaft.

The engraving, Fig. 1, shows a brass casting of a full cylinder, the light shading showing the brass, and the black shading the graphite surfaces on the inner circumference. The metal and graphite are flush at the bearing surfaces and equally distributed; in depth the graphite is generally half the thickness of the casting. The brass and graphite surfaces wear evenly, and no refilling with graphite composition is necessary, as the same lasts until the surface is worn away to the bottom of the groove.

The brass ribs or surfaces of the bearings and the shaft become filled with minute particles of graphite, and thus become smooth at the surfaces, and the continuing revolutions against the graphite surfaces of the bearing maintain

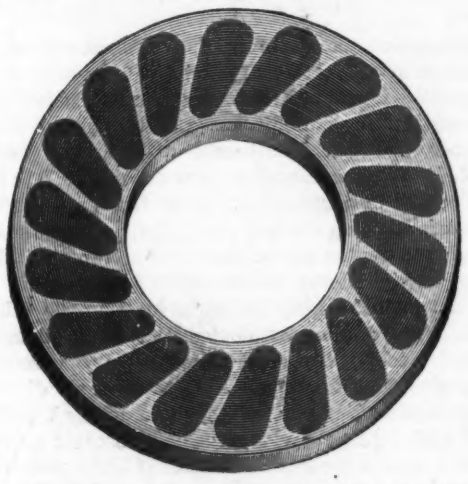


Fig. 3.—Graphite Washer for End Bearing.

this smoothness, to which is added the high polish which graphite imparts.

The engraving, Fig. 2, shows a brass casting for journal bearings, and Fig. 3 a collar washer filled with the graphite composition.

These graphite bearings have been in use for some time time, with excellent success, and are now being introduced in electrical machinery. The bearings require no oil, and hence the saving attending their use is claimed to be considerable.

Electromotive Force of Amalgams.

Experiments on the E. M. F. of amalgams immersed in an an electrolyte such as zinc sulphate or dilute sulphuric acid have been made by Crova, in Germany, Gaugain, in France, and Hockin and Taylor in England. It was found that excessively small traces of zinc or cadmium made a marked difference in the E. M. F. of mercury. Thus an amalgam investigated by Hockin and Taylor, consisting of 1 part zinc to 23.6 million parts of mercury in sulphate of zinc, was discovered to be more positive than pure mercury by 0.01 volt, and an amalgam composed of 1 part cadmium in 5.7 million parts of mercury was shown to be more positive than pure mercury by 0.09 volt. A German scientist, Herr S. Lindeck, in a recent paper, contributed to the *Ann. Phys. Chem.* [2], 35, 311-331, describes a series of experiments that he has made on amalgams of zinc, cadmium, silver, lead and tin. The results of this investigation are graphically exhibited by means of curves, in which the percentage of the metal alloyed with the mercury is plotted against the corresponding change in the difference of potential. Hockin and Taylor's results are confirmed, and by comparing these curves Lindeck infers the following conclusions: 1. The higher the position of a metal in the electromotive series, the higher will the addition of a slight trace of it raise the position of mercury in the series. 2. A further addition of metal produces scarcely any effect; the amalgam containing a mere trace of the metal occupies practically the same position in the series as a bar of amalgamated metal. 3. In whatever proportions silver and mercury be amalgamated, the amalgam occupies approximately the same position in the series as that occupied by pure mercury.

The Electrical Execution Investigation.

The hearing of testimony before the referee, Mr. Tracy Becker, of Albany, for the purpose of throwing additional light on the vexed question whether electricity is an effective and painless means of inflicting the death penalty on criminals, has been continued throughout last week. Although the inquiry will be continued this week in this city, and concluded in Buffalo, enough theory and practical experience has already been brought forward to create a widespread distrust of the suitability of the electric current for the infliction of death.

On Monday morning Subway Commissioner Gibbens was called to the chair. He thought it was a matter of uncertainty whether an electric current could be generated which would inevitably kill any individual, and, also, whether what would kill one would kill another. He was present at Mr. Harold P. Brown's dog-killing experiments at Columbia College last year. The dogs appeared to be suffering horrible agony, and it was one of the most frightful sights he had ever seen.

When Assistant Attorney-General Poste put the specific question, "In your opinion can an electrical current be given of such energy as to kill human beings if properly applied?" Mr. Gibbens replied, "I have grave doubts about it. I don't know."

Mr. John Noble, an electrician of the Westinghouse Company, then testified as to experiments made on the previous Friday at the Edison laboratory, with the view to determine the electrical resistance of the human body. Mr. Hatch, Kemmler's lawyer, was the subject, and the readings from four tests with the Wheatstone bridge were 1,360, 1,800, 9,870 and 8,170 ohms, respectively.

Alexander McAdie, "atmospheric electrician," then spoke as to the uncertainty of the effect of the electric current. He said it depended altogether on the physical condition of the man and his natural power of resistance. The current might traverse one side of his body only, in which case that side would be paralyzed while the other side was unharmed. The issue would be largely dependent on the thickness of the skin and whether the subject was stout or thin. If the current went through a man without striking a vital part he might be burned to charcoal. Wet sponges placed on the electrodes would prevent burning for a short time, but only temporarily. If the sponges were kept wet, and changed, the current might be deflected, and the subject would suffer untold agony, to which death by the rope would be a thousand times preferable. Mr. McAdie gave several instances of persons who were supposed to have been killed by electricity and afterwards recovered.

Dr. Frederick Peterson, who has been associated with Mr. Harold P. Brown in the various series of experiments with electricity on animals, took the stand on Tuesday morning. He said that vivisection shows conclusively that an animal can endure a severer attack on life than a man. He thought that an electric current could be produced by artificial means and be so applied to a human being as to cause death in every case instantly and painlessly and without burning the subject.

At the conclusion of Dr. Peterson's testimony Referee Becker remarked: "There seems to be a considerable amount of uncertainty as to the operation of electricity. Now, don't you regard the rope method as a dead sure thing?" "I do," replied Dr. Peterson.

Mr. John H. Noble was recalled by Mr. Hatch, and described how he received a shock while fixing a 1,050 volt dynamo, used for 1,500 lights about fifteen months ago. His fingers were burned, and did not get well for three weeks. In deciding how much force is necessary to kill, he said there must be a volt of E. M. F. for every ohm of resistance, so that a man whose resistance is 1,200 ohms would require 1,200 volts to kill him. The capacity of the Westinghouse dynamo selected by Mr. Harold P. Brown for the use of the State was only 1,050 volts, and could not be increased more than 200 or 300 volts without danger, so that if a man's resistance were 2,500 ohms the machine could not do the work.

Mr. Francis W. Jones, electrician of the Postal Telegraph-Cable Company and general manager of the United Lines Telegraph Company, was then put upon the stand, and testified as to the varying resistances shown by men on whom he had experimented. Using one cell, he found that his own resistance was 80,000 ohms, and with two cells, 37,000 ohms. With one cell, the next time, it was 31,000, and then with ten cells again it was 24,500. Two minutes after, with one cell it was 36,500, and with ten cells 21,500 ohms. Further tests with ten cells gave 17,000, 21,000 and 16,000 ohms, respectively.

Mr. Jones was of opinion that it would be impossible to fix a standard of voltage necessary to produce death, as men differed so much in their make up. With regard to the 1,000-volt machine with which it is proposed to operate on Kemmler, he considered the effect a matter of absolute uncertainty.

The most interesting episode of the investigation occurred on Thursday morning, when Commodore Gerry, who has come specially from Martha's Vineyard, was subjected to a crucial cross examination by Mr. Cockran for the purpose of finding out how it was that execution by electricity had become law on such apparently scant consideration. Mr. Gerry, who gave his testimony in a ready, straightforward and exceedingly intelligent manner, said that the commission of which he was chairman was assisted by Dr. A. P. Southworth, of Buffalo, and Matthew Hale, of Albany, and had considered forty methods of inflicting death; but had at last weeded these down to four, viz., the guillotine, the garrote, poison and electricity. The first was rejected because of its traditions, and its ghastly connection with the French revolution. The garrote, which was very effective, and had much to recommend it, was used by only one civilized country, Spain, and was, moreover, a relic of barbarism, and disfigured the criminal. Prussic acid was considered, but death from it was not certain, as it became decomposed, and, moreover, the smell was dangerous to those who handled it. It also required to be administered by a man of considerable medical knowledge, and no one of sufficient ability would consent to become a public executioner. Morphine was suggested, but the difficulty was to find what dose would prove fatal in each case, and the medical profession protested against the prejudice it might cause in the public mind. Otherwise Mr. Gerry was strongly in favor of it as a painless and humane death-compeller. The fourth method, electricity, was finally decided on. The Commission issued circulars and sent them to the various judges and doctors throughout the State, asking them which of the four methods named they thought better than hanging. Two hundred and seventy-five answers were received. Eighty-one thought hanging good enough, seventy-five advocated electricity, and the rest were scattered. Mr. Gerry went very fully into the steps by which the commission arrived at its final decision.

Dr. Landon Cotter Gray, professor of nervous diseases at the Polyclinic School of Medicine, New York, was next called. He was decidedly averse to the opinion that electricity was a certain means of killing, and stated that the variation of resistance in the human body sometimes extended from 550,000 to 1,500 ohms.

The feature of Friday's examination was the testimony of a man who would make his fortune in a dime museum as an electrical glutton.

Alfred West, of 441 West Forty-seventh street, gave a very graphic description of the way in which one bright morning, some years ago, as he was drinking in the balmy air at Fort Lee on the Hudson, he was struck by an electric bolt. It played all sorts of pranks, tearing off his shirt, and scattering his clothing promiscuously, dancing all over his body and tattooing his chest. He lost consciousness, and it was half an hour before he came to.

Mr. T. Carpenter Smith, of the Westinghouse Company, then gave his experience of the reception at sundry times of shocks of 1,000 volts and over of alternating current.

The hearing will be continued this week.

Electrical Engineering at Johns Hopkins University.

In order to meet the growing demand for instruction in electrical engineering, the Johns Hopkins University has now made provision for the instruction of graduate, special and undergraduate students in this branch. Practical and theoretical instruction is given in applied electricity and mechanical engineering.

The courses are under the general oversight of the Director of the Physical Laboratory, Professor Rowland, and the chief instruction is given by Associate Prof. Louis Duncan, Ph. D., and by Assistant Engineer W. F. C. Hasson, U. S. Navy, both of them graduates of the U. S. Naval Academy.

Students taking the advanced course are expected to have had a good general education, to possess a fair knowledge of French and German, and to be acquainted with mathematics through the differential and integral calculus. This course is adapted to the wants of graduates of this university who have taken the undergraduate course named below, and to other students who have had a like preparation. The work extends through two years.

Mr. Harold P. Brown's Reply to Mr. Gutmann.

To the Editors of The Electrical World:

Last spring Prof. Elihu Thomson admitted to the writer that he regarded the high tension alternating current as dangerous and that he had instructed his subordinates to handle and sell it as such. That was a manly and honorable admission. Last week, if I understood him correctly, Mr. F. L. Pope in his testimony before Referee Becker in the Kemmler case, stated that he considered the alternating current to be more dangerous than the continuous. One can respect men like these, who will admit the truth even when it is apparently against their business interests, rather than stoop to evasion or misrepresentation. Mr. L. Gutmann, however, insists upon placing himself in a different class of the electrical fraternity; he is, I believe, an employé of an alternating current company and has some inventions in the same line that must be promoted. He, therefore, sees fit to fill to overflowing a page in your valuable paper in which he maintains that anything which he does not believe is of course untrue, because it does not accord with his views and his interests.

He states by implication that Mr. A. E. Kennelly, an electrician whose high standing is admitted on both sides of the Atlantic, is incompetent to make galvometer readings, and that Dr. Frederick Peterson and other prominent specialists were imposed upon by the writer. Life is too short and time too valuable to enter into a controversy on these points; but objections to my experiments at this late date are quite out of place, especially when coming from Mr. Gutmann. I sent to the station with which, I believe, he was then connected several invitations requesting its electricians to attend and bring their instruments. In compliance with an anonymous letter which I attribute to some one connected with the same station, I published the same invitation in the *Evening Post*. At the first Columbia College demonstration I requested any who wished to do so to come forward with instruments and check up all measurements and connections. Dr. Schuyler S. Wheeler and Mr. T. Carpenter Smith responded, and at my second demonstration Dr. Wheeler again assisted. It will be evident to any fair-minded person that I would not have acted in this manner had I wished to deceive. Mr. G. is alone to blame for not accepting my invitation. Now, if he wants facts which prove that deaths have occurred from touching waterproof insulated secondary wires on the system I believe he represents, if he wants a list of the deaths from the alternating current in this country and Europe (one of the latter being from a pressure of fifty volts), I shall be glad to enlighten him. If he investigates the subject he will be confronted with grim facts which do not at all accord with his peculiar theories. And if he is really serious in his criticisms of my experiments, I will ask why he does not disprove them by making tests himself. He may answer, as he did in a letter mailed to me last fall, that, unfortunately, his position is such that he cannot command the necessary apparatus. Very well, I can command it and will give him an opportunity to prove his position by repeating any of my alternating current experiments with a full-sized "station" having complete equipment of "protective" converters. All necessary instruments will be at hand, and competent observers to bear witness to my overthrow. But Mr. G. must himself provide the subjects which must approximate in size and weight to those used by me. If he objects to animals and *really believes* that the converters will protect him, let him put himself in circuit. Even here I will allow him to put in series with himself a dead resistance equivalent to his own when measured with large and saturated contacts.

However, I will require him to present to me letters from the chief electricians of his company and of the Thomson-Houston Electric Company, which, I am informed, controls the former. These letters must vouch for his ability to handle the instruments, guarantee against any loss or breakage he may cause, and request that I allow him the above-mentioned opportunity.

In conclusion I will suggest to him that sarcasm and vituperation prove nothing but the weakness of the case they are employed to sustain.

NEW YORK CITY. HAROLD P. BROWN.

The Electric Light Convention Train.

We are informed by Secretary Garratt that applications for tickets on the special Pullman train from New York to Niagara Falls, via the Erie Railroad, Aug. 5, are coming in with gratifying promptness. Quite a number of seats in the ladies' car have been secured by gentlemen who will have their wives and daughters with them, while the composite car, which was so popular on the Chicago train last February, still proves a favorite among those not accompanied by ladies, though many prefer seats in the forward cars, which will be provided with card tables and other means of recreation. Although the prospect is very encouraging, not enough applications have yet been received to secure the train, and gentlemen who will attend the Niagara Falls Electric Light Convention are urged to secure tickets at once at the headquarters of the Association, 18 Cortlandt street, New York, or at the office of the ELECTRICAL WORLD. Ten dollars covers the ticket and Pullman seat.

The Erie Railroad is taking great pains to make this train one of the finest ever run out of New York; and every one will be pleased to learn that the same commissary who provided so well for the famous Chicago train, and who still has vivid recollections of the surprising tax which that expedition made upon his resources, has been secured to preside over the wants of the Niagara Falls party. Breakfast, dinner and supper will be served in a new dining car in the usual elegant style of the Pullman service.

Reporting the Recent Sullivan-Kilrain Prize Fight.

Although the exact location of the ground upon which the recent prize fight between Sullivan aud Kilrain was unknown to outsiders, the New York *World* made arrangements to have their office in direct telegraphic communication with the battle ground. An expert was given the order and quickly devised a scheme for a portable field telegraph line long enough to reach from any point liable to be selected to the nearest telegraph station. Mr. H. B. Thayer, of the Western Electric Company, promised to have the appliances ready in forty-eight hours. He obeyed instructions, and rode to the *World* office on the truck bearing the wire and instruments, all of which were properly and promptly packed and forwarded by express to New Orleans, whither three expert telegraph operators were also sent with instructions to get the first news of the fight to New York regardless of expense.

The order comprised four miles of telegraph cable. This was composed of three No. 22 copper wires heavily insulated with okonite and covered with stout braid. The conductors were made in mile lengths and placed on reels, which in turn were stowed in boxes so arranged that the cable could be unreeled from the rear of a truck, or the reels could, if necessary, be transported by a man where vehicles could not penetrate. Suitable connections for splicing the cables were provided, and also a quantity of compound and tape for covering and insulating the joints, as the cable was guaranteed to work as well under water as above ground. A supply of iron sockets three feet long was provided, and also 12-foot poles made to fit in the sockets aud bearing roller wheels at the top. The sockets were to be driven in the ground and the poles inserted to support the line at road crossings to protect it from vehicles and marauders, and the wheel in the top was for the wire to slide over without friction. For either end of the line ground connections were provided in the shape of four-foot iron stakes having holes and thumb-screws to hold the end of the wire. Twenty cells of Callaud gravity battery in two boxes, and three sets of telegraph instruments, comprising box relays and keys, completed the outfit, one of the instruments being intended to provide against accidents.

This plan, of course, did not comprehend the shutting off of all possibility of communication with the outside world by the severing of the telegraph wires which occurred, and under ordinary circumstances it must have worked, and resulted in the *World* announcing the details of the great prize-fight in advance of all its contemporaries. The arrangements were all successfully made, and the field telegraph tested and found to be in good working order before the telegraph wires were cut, which, of course, cut off all communication.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, July 15, 1889.

Mr. Wm. Brookfield, of the Bushwick Glass Works, has moved from 45 Cliff street to 83 Fulton, room 11, the new building of the Market and Fulton National Bank.

Mr. J. W. Packard, inventor of the packard Pump, made by Mr. Norman Hubbard, of Brooklyn, and used in a number of lamp factories, is at present recuperating at his home at Warren, O.

Edison Consolidation.—Under the recent consolidation of the various Edison electric companies, the United Edison Manufacturing Company, at 65 Fifth avenue, becomes the successor of the Edison United Manufacturing Company, and will liquidate their business.

More Subway Explosions.—On the evening of July 19 two explosions occurred in the electric subways, one at 19th street, and and another at 20th street. The explosions followed each other in rapid succession, and were no doubt due to the accumulation of illuminating gas. Beyond the lifting of the pavement and the blowing out of a manhole cover no damage was done.

The Slattery System in Jersey City, N. J.—Mr. H. C. Adams, the general New York agent for the Fort Wayne Jenney Electric Light Company, at 115 Broadway, informs me that they are now furnishing to the Jersey City Electric Light Company three 1,000 16 c. p. incandescent alternating dynamos of the Slattery system. The Jersey City Company are putting up a fine building for this plant.

Copper Connectors for Joining Wires.—As demonstrating the value of the connectors made by the Messrs. C. McIntyre & Co., of Newark, N. J., I would mention that they have just filled a large order for copper connectors to be used for joining hard-drawn copper wire for the International Bell Telephone Company, of Antwerp, Belgium. These connections are made of the best lake copper, and completely obviate the necessity of soldering the joints. These connectors and branches are also employed for underground wire, and are now being used by all the companies putting wires under ground in New York City, and with the best results.

The Sawyer-Man Company shipped 93,000 lamps during the month of June from their factory in this city. The daily capacity of the factory, which has just been fully equipped, is 5,000 lamps

All the various departments are now in complete running order, including the new laboratory building. The factory is equipped with boilers of 750 h. p., the Westinghouse compound engines being employed, two of 200 h. p., one of 125 h. p., three of 25 h. p., and a number of smaller engines for running the dynamos, Packard pumps and other machinery of the factory. The factory is now in condition to fill orders at the shortest notice.

The Bridgeport Brass and Copper Company have just issued their new catalogue containing a full description of all their various products. It would take me a long time to enter into the details of this work, but I will mention that among its contents is to be found a full description of copper and brass wire for electric work, German silver sheet, wire and tubing, etc. The work also contains tables of the weights and sizes of copper wire and the differences between existing wire gauges, together with other useful information.

The Phœnix Glass Company have just brought out a novelty in the shape of shades for incandescent lamps. These are made in the form of stalactites, and are made in opalescent, etched and cut glass. Mr. H. T. Patterson, of this company, has just returned from an extended trip West, having been present at the recent conflagration at Seattle, W. T. Mr. Patterson arrived at Seattle at 1 o'clock P. M. and left by steamer at 7 o'clock the same evening. The dock from which he sailed was reduced to ashes 20 minutes later. Mr. Patterson reports that the incandescent light business is most encouraging in the West, even the bootblacks and street venders using incandescent lamps, notably at Denver, Col.

A Storage Car on Seventh Avenue.—Last week the new car of the Electric Car Company of America, equipped with the Gibson storage battery, was given its first trial trip on the Broadway and Seventh Avenue Railway in this city. The car is equipped with two motors connected direct to the axles by means of worm gearing, and carries 90 cells of the Gibson storage battery. The car, in charge of Mr. G. H. Condict, was run from the stable on Fiftieth street to the Battery and return, a distance of ten miles, and worked admirably. Mr. Thompson, the president of the road, and Mr. Newall, the superintendent, expressed themselves as well pleased with the performance of the car. A noticeable feature of the motors employed is the entire absence of sparking.

The Ball Electric Light Company seem to be holding their own in the way of sales. They report the following as among their late deliveries and state that they are far behind their present orders, and that it is their intention to immediately increase their manufacturing facilities. They will issue a new catalogue shortly, which may be had upon application at the office of the company, No. 18 Cortlandt street. The catalogue will contain, in addition to the ordinary description of the dynamos and lamps, a large number of testimonials from some of the leading firms using it and very valuable instructions for the care and operation of electric light dynamos. The book will be of interest to engineers and electricians in charge of plants of whatever system. The following are the plants recently sold:

	Arc.
Jersey City Electric Light Company, New Jersey, N. J.	60
C. D. Wright, Petersburgh, Ill. (increase)	70
Stoughton Lighting Company, Stoughton, Mass.	70
Central Pacific Milling & Manufacturing Company, Redwood, Cal.	25
The American Net & Twine Works, Boston, Mass.	25
G. W. McAlpine Company, Cincinnati, Ohio	20
The New Haven Copper Company, Seymour, Conn.	25
Campbell & Dick, Pittsburgh, Pa.	52
James Swan, Seymour, Conn.	25
W. S. Heger, Wilmington, Del.	8
Merchants Electric Light & Power Company, Birmingham, Ala.	80
Point Pleasant Electric Light & Power Company, Point Pleasant, W. Va.	25
The Oriental Hotel, 39th street and Broadway, New York City.	25
American Amusement Syndicate Company, Paris, France (increase)	70
F. C. Page, Rockaway Beach, N. Y.	26
Union Dredging Company, 34 Pine street, New York City	8
W. A. Knapp, Beloit, Wis. (increase)	70
Virginia Electric Light Company, Virginia, Ill.	50
Wamsutta Mills, New Bedford, Mass. (increase)	95
Norwalk Gas Company, Norwalk, Conn.	140
East Albany Gas Light Company, Greenbush, N. Y.	26
Chester Pipe & Tube Company, Chester, Pa.	32
West Chester Gas Light Company, West Chester, Pa.	25
Ocean Shore Park Association Princess, Anne County, Va.	40
F. A. Wunder, Chicago, Ill.	50
Ball Electric Light Company, Cincinnati, Ohio (increase)	30
	1,172

More Julien Storage Cars.—The equipment of the Fourth avenue line by means of the Julien storage cars seems to go on apace. Recently, car No. 7, which had been on the line for several months, and had run 7,000 miles, and carried nearly 80,000 passengers, was displaced by one of the new Stevenson cars. The old car during its entire life did not cost one dollar for repairs or alterations, but was retired only to make room for cars better suited to the road. There are now five new Stevenson cars running, and two additional are being turned out each week for the Julien Traction Company. They are said to be the finest cars of this kind that have ever been built, and the ease and comfort which they afford is continually commented on by the passengers as well as the officials of the road. W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, July 20, 1889.

Mr. S. Rosenstamm, of Lewisohn Brothers, the well-known makers of copper wire, was in the city this week.

Salem, Mass.—At a regular meeting of the Board of Aldermen the directors of the Essex electric street railroad petitioned for a location in this city.

Bell Telephone and Western Union.—There were rumors in Boston last week of approaching trouble between the telephone people and the Western Union Company over the long distance telephone business.

Edison Plant.—The new Ames Building, at the corner of Washington and Court streets, will be equipped with an Edison incandescent light plant of 1,000 lights. Power will be furnished by a 50 h. p. McIntosh & Seymour engine. The specifications call for Habirshaw Okonite wire.

Mr. A. R. Foote, of Cincinnati, was in the city this week. Mr Foote is Chairman of the National Committee of the National Electric Light Association on State and Municipal Legislation, and is author of the book which is meeting with so much deserved success, "Economic Value of Electric Light and Power.

Woburn, Mass.—The Thomson-Houston Electric Light Company, of this city, have contracted with the Wright Electrical Engineering Company, of Boston, for the extension of their circuits, to include both arc and incandescent lights. About 1,200 poles and over 40 miles of wire will be required.

Providence, R. I.—The Western Union Telegraph Company has reduced the rates of delivery through the state, and the charges are now 15 cents for one mile and a half, and 25 cents for three miles. It is a practical reduction all around of 12½ cents on long distances, while the free delivery is greatly enlarged.

The Thomson European Electric Welding Company has been organized at Portland, Me., by the election of the following gentlemen as directors: Messrs. Oliver Ames, S. Endicott Peabody, B. F. Spinney, J. N. Smith, W. A. Boland, Charlton T. Lewis, S. A. Van Hoffman, S. D. Babcock, and Henry D. Hyde. Hon. Oliver Ames was chosen president, W. A. Boland, treasurer. The capital stock is $1,500,000.

The Edison Illuminating Company, of Boston, under the efficient management of Mr. C. L. Edgar, has increased its business wonderfully within the past few months. More power has been required to produce the light which is in great demand, and Mr. Edgar has just placed an order with the Jarvis Engineering Company for five Armington & Sims engines, aggregating 750 h. p.

Springfield, Mass.—The Springfield Electric Light Company have contracted to light the streets of the city with arc and incandescent lights, and the committee on street lighting have signed a contract with the Marr Construction Company, of Boston, for 300 electric light poles and the necessary mast arms. The contract calls for poles of hard Georgia pine, to be set in the ground 6 feet, and the part in the ground to be covered by a mixture of coal tar and pitch. The work is to be completed by the 1st of October.

Frank Ridlon & Co.—Besides the general bric-a-brac and second-hand dynamo and lamp business, Mr. Ridlon has lately assumed the agency of the Perret motor, manufactured by the Elektron Manufacturing Company, of Brooklyn. N. Y., and with his usual energy is pushing these excellent little machines into universal favor Mr. Ridlon has just supplied the Woonsocket Electric Light Company with two 1-6 h. p. motors, and he has also installed two of ⅛ h. p. in the offices of the Thomson-Houston Company, in this city, one in the supply department and one in the motor department.

The West End Street Railroad Company.—The board of Aldermen have at last granted permission to trim the trees on Boylston Street, opposite the public gardens, and the electric cars on the Brighton & Park Square divisions are now enabled to run right into the city on the overhead system. The ride from the Boston & Providence R. R. depot to Chestnut Hill or Allston is most enjoyable, and after leaving the busier streets of the city the speed is fast enough to suit the most exacting, and forms a good method of cooling off during the warm summer evenings. A proposition has been made to the stockholders to issue $4,000,000 of new commercial stock, the proceeds to be used for the payment of the new electric system.

The Wright Electrical Engineering Company have now moved into their new large and commodious quarters in the Estes Press building, where they will enjoy better facilities for successfully carrying on their rapidly increasing business. In order to better cope with the press of work on hand, it has been found necessary to make some changes in the officers of the company, and Mr. D. A. Andrews, who has hitherto been President, has retired in favor of Mr. Frank Ridlon. Mr. Andrews will now assume the responsibilities of treasurer. With Mr. Ridlon as president and Mr. Wright as managing director, it is safe to assume that the Wright Electrical Engineering Company will achieve even more success in the future than it has so signally done in the past.

Mather Electric Company.—I have recently seen a list of the plants delivered and contracted for by the Mather Electric Company for the past year, which is almost too long to read. It serves at least to prove that the Mather Electric Company are meeting with success, and are enjoying their share of the electric light business. Among the most recent sales are the following: C. V. N. Kittredge, Denver, Col., 600 lights; The Republican Publishing Company, Denver, Col., 300 lights; the Progress Club, New York, 1,300 lights; the Howland Mill, New Bedford, 650 lights; Evelyn Flats, New York, 500 lights; Soldier's Home, Grand Rapids, Mich., 500 lights; Duluth Imperial Mills, Duluth, Minn., 200 lights; Joseph Bancroft & Sons., Rockford, Ill., 1,300 lights; Gilbert Paper Company, Menosha, Wis., (increase) 25 lights; Nashua Glazed Card and Paper Company, Nashua, N. H., 400 lights.

Meeting of the National Electric Light Association at Niagara Falls.—Col. C. M. Ransom has issued a circular letter to New England members of the National Electric Light Association, giving them information as to the best method of reaching Niagara Falls. A special train will leave the Fitchburg depot, Causeway street, Boston, on Aug. 5, at 3 P. M., and will go via the Hoosac Tunnel, arriving at Niagara at 7 A. M., Tuesday, in time for breakfast at the International Hotel, where rooms should be secured at once by letter. The railroad fare for the round trip will be $14.20—$10.65 going and $3.55 returning. The sleeping car accommodations will probably cost about $2 each, and special arrangements are being made for those who wish to be accompanied by ladies. Further particulars can be obtained from Colonel Ransom, who will also procure tickets and sleeping car accommodation on receipt of check or postal order for $13, to cover the outgoing expenses.

The Walworth Manufacturing Company are meeting with remarkable success with their Bessemer steel pole and bracket for the equipment of electric railroads, an excellent idea of which may be had from the illustration in their advertisement. The pole is hollow, and adjustable like the parts of a telescope. This company recently secured the order from the West End railway for the poles necessary in the electrical equipment of its lines in the city, and this order alone involves thousands of tons of steel. These poles are neat and strong, and where it is necessary to have poles in a city, they are a great improvement over the unsightly wooden ones. They can be adapted for any system, and the company are in daily receipt of inquiries as to prices. Among the most recent orders received may be cited those from the following companies: Hoosac Valley R. R., North Adams, Mass.; the Quincy & Boston R. R.; the Lowell & Dracut R. R.; Newburyport & Amesbury R. R.; Newport, R.I., R.R.; Albany & Watervliet R. R., Albany, N.Y.; the the Fulton County R. R., Atlanta, Ga.; the Short Electric R. R. Cleveland, O.; Eckington & Soldiers' Home R. R., Washington, D. C.

The Wainwright Manufacturing Company of Massachusetts.—Engineers will be interested in the following report by Mr. George N. Comly, M. E., on a test of two Wainwright copper coil feed-water heaters, built by the Wainwright Manufacturing Company of Massachusetts:

Duration of trial	72 hours.
Steam pressure on boilers	81.61 pounds.
Temperature of feed-water entering the heaters	34.59 deg. Fahr.
" " leaving the heaters	208.51 "
Elevation of temperature in passing through the heaters	173.92 "
Percentage of saving in fuel by use of the heaters	17 26-100 pr. cnt

No back pressure was shown on indicator cards.

This report was unsolicited, and was given in a thoroughly disinterested manner, and to those who study the figures, will show the good qualities which this heater possesses. It is a remarkable showing, as it raises feed-water at an ordinary temperature to almost the boiling point before entering the boiler, without any perceptible expenditure of energy. A. C. S.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, July 20, 1889.

The Allegheny, Pa., City Council have called for bids for city lighting.

Lima, O.—Lemert & Gormley, of Bucyrus, are to be granted an electric light franchise.

Atchison, Kan., will, it is said, put in a Brush municipal arc plant for street lighting.

Seattle, W. T.—The Commercial Mill Company will put in a 750-light Westinghouse plant.

The Pana, Ill., City Council, July 11, called for bids for lighting the city with electricity.

Newnan, Ga.—A company is being organized for electric lighting by M. T. Collins and others.

The Sloan's Lake Electric Road, at Denver, will be built as soon as $50,000 is subscribed.

Sioux Falls, Dak., and East Sioux Falls will soon be connected by an electric railway system.

South Chicago.—A franchise has been granted to the South Chicago Electric Railway Company.

Banker D. N. Thomson, Butler, Mo., inspected several electric light systems in Chicago this week.

A. L. Ide & Son, Springfield, Ill., have secured the contract for lighting the State House for the sum of $4,000.

Fresno, Cal.—The Fresno Gas and Electric Light Company have bought a 50-light Thomson-Houston arc outfit.

Hot Springs, Ark.—Mr. E. Hogaboon is reported in the market for an incandescent plant to go in a large new hotel.

Circleville, O.—The Circleville Electric Light and Power Company has been incorporated with a capital stock of $20,000.

Liberty and Reed Springs, Mo., are to be connected with Kansas City by an electric motor line, a press dispatch states.

The San Francisco Board of Supervisors appropriated $20,000, July 5, for the establishment of a police telephone system.

Sacramento, Cal.—The Sacramento Electric Light Company has adopted the Brush alternating system for incandescent lighting.

A. C. Ragsdale, city electrician at Decatur, Ill., has added a new Hamilton-Corliss engine of 150 h. p. to the city electric light plant.

The Laclede Car Company, St. Louis, Mo., have just placed six new coaches 14 feet long on the Kansas City & Armourdale Electric Railway.

The Central Electric Company, Chicago, have placed in their office a handsome portrait of Capt. Willard L. Candee, of Okonite fame.

Mr. Harry Lawrence, 622 Geary street, San Francisco, Cal., has disposed of several hundred Knapp annunciators during the last few months.

The Duquesne Electric Railway Company, Pittsburgh, will have their underground system in operation on the west end lines in that city.

The Local Brush Electric Light Company recently organized in Atchison, Kan., proposes to put in a sixty arc light plant for city use at $13,000.

The Pana, Ill., Electric Light Company and the Springfield Coal Mining Company are each endeavoring to secure the contract for city lighting.

The Vandalia, Ill., City Council have accepted the proposition of the Light and Fuel Company for lighting the streets at a cost of $1,800 per annum.

Metropolis, Ill.—The Metropolis Electric Light Company has been formed by W. R. Brown, W. S. Thomas and W. O. Towle, with a capital stock of $10,000.

The Hedrick Street Railway, at Ottumway, Ia., some four miles in length, has been sold to parties who will at once arrange for an electric system.

The Racine Hardware Manufacturing Company, Racine, Wis., have recently placed five of their engines to be used in operating electric light plants.

The Western Electric Company's Factory at Chicago is to be still further enlarged by the addition of a north wing, to be occupied by the insulating department.

The West Side Electric Railway, in Kansas City, Kansas, began constructing its line June 28, having placed $125,000 in bonds. The Thomson-Houston system will be adopted.

Mr. J. Wayland Clarke, formerly connected with electrical enterprises in Chicago, is now president and treasurer of the Tacoma *Sunday Times*, Tacoma, Washington.

The City & Suburban Telegraph Association, of Cincinnati, have been granted permission to erect and maintain telegraph and telephone lines in the village of Avondale.

W. B. Dunnell, the Minneapolis architect, has drawn the plans for the new State reform school to be located at Red Wing, Minn., and to contain an incandescent electric light plant.

Peoria, Ill.—The Merchants' Light and Power Company, to do electric lighting, etc., has been formed by R. J. Singer, K. G. Pardell, J. Birks and others, with a capital stock of $75,000.

Pomeroy, O.—Mr. E. S. Trussell, the proprietor of the Pomeroy *Telegraph*, has secured a contract to light the streets of the city with 25 arcs for a period of five years from Oct. 1, 1889.

Portland, Ore., will soon have an electric street railway across Morrison street bridge to a point six miles southeast of the city, and work is progressing on the line across the steel bridge.

The Keystone Construction Company, Chicago, have secured the contract for a 500-light Westinghouse alternating current plant for street and commercial lighting at Dennison, O.

The Pittsburgh & Wilkensburg Railway Company, Pittsburgh, Pa., will apply, Aug 1, for the privilege of operating an electric railway between the East End and Wilkensburg, Pa.

The Edison Electric Light and Power Company, St. Paul, are experimenting with the McGinnis patent smoke consumer, and believe that its use reduced the fuel bill last month some $200.

Milwaukee, Wis., expects to have a parent electric light company locate its factory there shortly. The Edison Company are preparing plans and specifications for erecting a central station at Milwaukee, Wis.

The Southern Electrical Manufacturing and Supply Company, Limited, New Orleans, La., will soon place a new electric motor and fan on the market. They make a specialty of repairing all forms of electrical apparatus.

Mr. C. A. Brown, Manager of the Western Electric Company, Chicago, has kindly favored the Western office of THE ELECTRICAL WORLD with a handsome framed engraving of their factory and warehouse in New York.

The Western Electric Company, Chicago, have secured the contract for an electric light plant of twenty-five arc lamps of 2,000 candle-power capacity, the entire cost not to exceed $10,000, from the city of Goshen.

Incorporations.—The Galion Electric Carbon Company, Galion, Ohio; capital, $25,000. The Burlington, Wis, Edison Electric Light Conpany; capital stock, $15,000; incorporators, L. J. Smith, H. Wayne, Jr., B. Brehm.

Selma, Cal.—The Selma Gas and Electric Light Company has been formed, with a capital stock of $50,000, by H. C. Eggers and B. R. Woodworth, of Fresno, M. G. Elmore, of San Francisco, J. A. Stroud and J. E. Whitson, of Selma.

Racine, Wis.—The Badger Electric Light Company, Mr. P. H. Korst, manager and secretary, is introducing incandescents into Racine residences with good results, and has lately added to its plant in order to give increased service.

The St. Louis Board of Public Improvements have called for a report on the number, locality and condition of all the poles supporting electric wires in the city, and will hereafter regulate the erection and maintenance of same.

Mr. J. W. Gregory, of Garden City, Kan., suggests the use of the great underground stream beneath the Arkansas in furnishing water power to operate electric motors; and this water then to irrigate the arid portions of Western Kansas.

The Cincinnati City Council has directed the city solicitor to report under what conditions the city can contract for electric lights, and what rights and privileges have been granted to local companies in respect to the stringing of overhead lines.

Galena, Ill.—The City Council, by a majority vote on July 3, refused to accept the incandescent light system recently introduced there for illuminating the streets and public buildings, and which has been in operation for the last four months.

The Indianapolis Council granted the Citizens' Railway Company, on June 5, permission to use a system of storage batteries and electric motors on the Brightwood lines. It is now understood that the Julien Electric Traction Company will equip the cars.

San Jose, Cal.—The San José Light and Power Company has been formed by C. Otter. H. H. Kooser, E. W. Clayton, C. A. Hagan, H. J. Edwards, C. T. Ryland and A. Eaton to operate electric lights, electric railways, etc. The capital stock is $1,000,000.

Anderson & Douglas, of Minneapolis, have applied for an electric street railway franchise, promising electric lines subject to no contingent experiments, the best service, "and instead of asking the city to idemnify us, we offer to idemnify the city," etc.

Taylorville, Ill., has contracted with C. C. Travis, of Chicago, on July 2, for eighty 16 candle-power and twenty 32 candle-power lamps, for the term of five years, at a cost of $1,380 per year. The Thomson-Houston system to be used, and in operation within ninety days.

The Knapp Electrical Works, Chicago, sold over 19,000 2½ in. and 3-in. iron box bells last year, a recent inventory shows. An order for 200,000 patent thread protectors was filled this week, the company making a specialty of small metal work, and securing numerous contracts in that line.

The City of Alameda, Cal., owns seventeen-fortieths of the electric light plant, and leases twenty-three-fortieths from the Jenney Electric Company. This lease expires Jan. 1, 1890, when the city will probably purchase the entire plant. The question of issuing bonds for same is now being agitated.

Proposals Opened.—The bids for wiring the Minnesota Hospital for the Insane for electric lighting were opened by the trustees at the Merchant's Hotel, St. Paul, July 9. A. S. Huey, Minneapolis, three proposals, $1,030, $1,210, $1,370; Mather Electric Company, St. Paul, $800; Northwestern Electric Company, St. Paul, $850.

New Orleans, La.—An Edison 75-light incandescent plant has been installed in the sugar mill on the Ashton plantation near New Orleans. The Haller Tinware Manufacturing Company, New Orleans, have had installed one 5 h. p. Sprague motor to operate machinery, two 1 h. p., and one ½ h. p. Sprague motors to operate fans.

Decatur, Ill.—The Citizens' Electric Street Railway Company have their plant complete in every respect except installing the Thomson-Houston generator, which has been delayed en route. The two large Ide engines were furnished by A. L. Ide & Son, of Springfield, Ill. The Sprague electric system will be in full operation by Aug. 1.

The Milwaukee (Wis.) Telegraph Company has decided to test its franchise in court, as the majority of the Council advocate repealing it or making it a strictly conduit company. The company now have 50 arcs and 300 incandescents of the Western Electric system in operation, and have all arrangements completed for a rapid increase.

San Pedro, Cal.—The San Pedro Electric Light and Power Company has been formed with J. H. Dodson, president; D. R. Clay, treasurer; E. E. Peck, secretary and superintendent. The capital stock is $100,000, of which $80,000 is already subscribed. The plant of the company has been in highly satisfactory and uninterrupted operation since Jan. 1.

Indianapolis offers little inducement for the investment of capital in electrical industries, as the City Council are constantly worrying the local lighting companies. This week the city engineer directed that no more poles be erected, wires strung or lamps hung until the respective companies comply with certain requirements in a new ordinance passed after the repeal of the ordinance granting them rights and privileges, on the basis of which they invested their capital.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations upon telephone stocks as follows:

Chicago	$310@$325	Cumberland	$ 69@ $70
Central Union	59@ 60	Wisconsin	117@ 118
Michigan	84@ 85	Bell of Missouri	151@ 153
Great Southern	31@ 33	Iowa Union	23@ 25
Colorado	38@ 40	Missouri and Kansas	63@ 65
Rocky Mountain Bell	41@ 42		

The Cincinnati Electric Light and Power Company, having secured control of the Brush Electric Light Company's plant of 360 arc lights and the First Cincinnati Edison Illuminating Company's plant of 2,000 incandescent lights, have now contracted for 500 arcs and 2,000 incandescents of the Thomson-Houston system, and will at once proceed to organize a first-class light and power service. It is also hinted that they may possibly absorb the local Ball Electric Light Company's plant. The officers of the new company have not yet been elected.

Manitoba.—The Manitoba Electric and Gas Light Company have petitioned the government not to incorporate the Northwest Electric Company and the Electric Light and Power Company, alleging that great damage would result to their plant should the lines of these companies become fouled with their own, and also represent that the powers sought by the rival companies, seeking incorporation, are too large and sweeping in their character.

C. M. Webster, secretary of the Water-Power Company at Great Falls, Montana, is considering the advisability of utilizing the water-power in generating and transmitting electricity to operate machinery in the adjacent smelters and in the coal mines some few miles distant. The Missouri River is said to have "a fall of 512 feet within a few miles," and that "several thousand horse-power" in water-power can easily be secured there even during the dry season.

Incorporations.—Quincy Motor and Carrying Company, location Quincy, to operate railways by electricity or other motive power; capital stock $100,000; incorporators, E. H. Osborne, J. H. Duker, L. T. Dickason. Joliet and Lockport Electric Street Railway Company, location Joliet; to operate a street railway by horse or electric motor; capital stock $50,000; incorporators, C. H. Bacon, John R. McDonald and A. L. Moody. The Joliet road will have a Thomson-Houston equipment.

The East Side Street Railway Company, Kansas City, Mo., was incorporated July 2; capital stock, $250,000, divided into shares of $100 each. Board of Directors: W. H. Winants, trustee; E. L. Scarritt, W. E. Scarritt, J. H. North, Witten McDonald, F. C. Marsh, C. R. Hunt, E. A. Phillips. An electric system will be used. W. B. Knight will probably be the chief engineer. He expects to erect handsome iron poles in the centre of the street between the tracks for supporting the conductors.

Munson Belts for England.—Mr. J. H. Shay, the well-known representative of the Charles Munson Belting Company, of Chicago, has achieved a great triumph for American belting in securing the order for belting the entire Westinghouse station now being erected in London, England. This order comprises five belts 64 feet in length and 20 inches wide, and three 54 feet long and 14 inches wide. The Munson Belting Company naturally feel very proud at having secured this order, and they look upon it as a recognition of the superior quality of their product.

Grand Forks, Dak.—The Grand Forks Gas and Electric Company was organized last May and purchased the properties of the Dakota Gas and Fuel Company and the Grand Forks Incandescent Electric Light Company, comprising all the public lighting corporations in the city. The new company is stocked for $200,000. Mr. W. J. Murphy holds about one-third of the stock, the rest being distributed among thirteen other stockholders. Mr. Murphy is vice-president and general manager for the present.

The Kearney, Neb., Street Railway Company, following its reorganization, has closed a contract with W. J. Clark for a twelve mile equipment of the Thomson-Houston electric railway system between East Lawn, West Kearney and Kenwood, to be constructed without delay in the thorough manner adopted at the beginning of its railway work by the Thomson-Houston Electric Company. The railway company will utilize some of the water power so plentiful in Kearney to operate the Thomson-Houston generators, thus reducing the cost of maintenance to a minimum.

The Vogelgraphone.—The United States Vogelgraphone and Electric Microphone Far-Distance-Speaking Instrument Company, President E. W. Vogel, Secretary and Treasurer Adolph Gray, the incorporation of which was noted some time since in THE ELECTRICAL WORLD, is about to offer for sale stock, containing the following stipulation: "Ten per cent. interest guaranteed on each and every coupon presented through the Vogelgraphone Bank each and every year until the year 1901." The bank has not been established; the tangible assets of the company are not large, and all the patents on the instrument have not yet been granted.

The Northwest Electric Construction and Supply Company, St. Paul, have moved into the "Electric Block," at 403 and 405 Sibley street, having fitted up three floors and basement for the transaction of their rapidly-growing business. The first floor contains the offices, and a handsome display room and shipping room. The basement and fourth story are used for storing heavy or bulky goods. The second floor is devoted to printing purposes, the machinery being operated by a Thomson-Houston motor. The third floor is being arranged for the use of the St. Paul Electric Club. The private apartments of the president will be on this floor.

Denver, Col., made liberal use of both incandescent and Brush arc lights with colored globes on the Fourth of July. The *Rocky Mountain News*, among its other decorations, had one window woven full of red, white and blue bunting thickly studded with stars and with incandescent lamps arranged in the centre to read "The News." The American House, so well known to all the older travelers, had a star six feet in height made of colored incandescent bulbs. A banner of lights was strung across the street, and on the public buildings were mottos and dates, "The day we celebrate" and "1776-1889" being the most prominent, all in colored bulbs.

The Central Thomson-Houston Electric Company, of Cincinnati, have closed the following contracts for electric light apparatus, to be installed in Ohio towns: Van Wert Gas Light Company, 70 arc lights; Bellaire Gas Light Company, 70 arc lights; Athens Gas Light Company, 50 arc lights; Pomery Electric Light Company, 35 arc lights; Canal Dover Electric Light Company, 50 arc lights. Also, the following arc and alternating incandescent apparatus to be installed in Kentucky towns: Lexington Electric Light Company, 50 arc lights and 650 incandescents; Citizens' Electric Light Company, Covington, 35 arc lights and 1,300 incandescents.

West Virginia.—The central station of the Bramwell-Pocahontas Electric Light Company is now being erected at Mill Creek, W. Va., to light the mining towns of Mill Creek, Bramwell, Freeman's and Pocahontas. The capital stock of $15,000, held principally by local coal operators, may be increased up to $150,000. The contract for plant has been made with the Westinghouse Company, who will furnish a 750-light alternating machine and a 65 h. p. Westinghouse engine. There will be about 7½ miles of circuit. Mr. W. S. Atchison, the superintendent, reports that the plant will be in operation by Sept. 1. Mine lighting will be done, and it is also the intention to try electricity in place of the mules.

Toledo, O.—The new electrical road in Toledo of the Thomson-Houston system was finished last week. It is over three miles long, and runs from Summitt street to Glassboro, where the new factory of the Schaefer Electric Supply Company is now building at a cost of $10,000, to be ready for occupation by the middle of September, with a capacity of 200 hands. Another electrical road, 21 miles long, will be built this year, and the Thomson-Houston system will be used. Large extensions on buildings are being made by the Toledo Electric Company, using about 500 Thomson-Houston arc lights and 4,000 16 c.p. of the alternating system. General Manager Stevens has returned from his Eastern trip, during which he ordered two 150 h. p. Armington & Sims engines, and another thousand light alternating machine. The incandescent lights, as well as arc lights, give excellent results. The new Opera-House in Toledo is being lighted by the Thomson-Houston system, with both incandescent and arc. Mr. J. F. Schaefer is the general manager of the Schaefer Electric Supply Company above mentioned.

The Detroit & Cleveland Steam Navigation Company, to insure the safety of their patrons, have had placed on their magnificent water palaces complete installations of the Parish & Peck signal system, permitting of instant communication between pilot-house and engine room. For instance, on entering a harbor, the captain standing on either side of the steamer's bridge rapidly conveys his orders to the engineer, a second bell in the pilot house also acting in unison, thus indicating to the captain exactly what signal he gave, and doing away with all possibility of confusion arising from the misunderstanding of signals. Suitable push buttons or other forms of circuit breakers are placed at various points around the boat, adding much to the quickness and certainty of controlling the boats' movements, and the system is so arranged that should the bell cord break a danger signal goes in as usual. The electrical circuit required in operating the system is furnished by two cells of the Detroit storage battery, which require recharging once in sixty to ninety days.

F. DE L.

SOUTHERN NOTES.

LOUISVILLE, Ky., July 18, 1889.

Another Thomson-Houston incandescent plant has just been put in operation here at the Falls City Woolen Mills on Preston street.

The Gaynor Electric Company, of this city, have recently installed an arc and incandescent plant at the new pumping station of the Louisville Water Works, consisting of four 2,000 c. p. arc lamps and eight 75 c. p. incandescent. They are also wiring a large hotel in Pewee Valley for a 300-drop annunciator.

The National Automatic Fire Alarm Company will soon open an office in this city. A local company has been formed and a system established in connection with the Fire Department. The system has been thoroughly examined by Major Hughes, Chief of the Fire Department, and he declares that it is the best that has ever been invented. Several of the large wholesale houses on Main street are now equipped with the apparatus, and connections are made with the Salvage Corps, and also the central fire alarm station, which shows at a glance the exact location in the building where the fire is burning.

F.

DALLAS, Tex., July 15, 1889.

Mr. Owen J. Cook, president of the Queen City Electric Light and Power Company, has gone to Fort Wayne and other cities in the interest of his company.

Lighting the Texas Capitol.—Work on the installation of the lighting plant at the Capitol Buildings at Austin will begin shortly. This will be the largest isolated plant in the southwest, and it is but fitting that it should be done in a most perfect manner.

Mr. J. M. Oram, the genial City Electrician, president of the Dallas Electrical Society and inventor of the Oram time repeater, steps unusually high at present, a young electrician having arrived at his home July 9. The society proposes to adopt him as its "Mascot."

Mr. Norman Raff, representing both the phonograph and graphophone companies, has made Dallas his headquarters. A large number of people have listened to the wonderful little machines, and we confidently expect to see them in every office in Dallas in the near future. Mr. Raff is a most genial and popular representative.

The Fort Worth Electric Street Railway will be opened for traffic in a few days. The trial trips were made under the personal supervision of Mr. Rea, who, by the way, is a most genial and pleasant gentleman, and everything was found satisfactory. A great deal of interest has been taken by other Texas cities in the movement, and it is stated on good authority that a number of the large cities in the State are negotiating with the various electric railway companies. West Dallas, a suburb of Dallas, has already taken the initiatory steps, and rumor has it that the contract was closed a few days since with a well-known company for a complete railway plant. Dallas is expected to fall into line in the near future.

Motors in Dallas.—Dallas is certainly coming to the fore on the motor question. The Queen City Company started its motor circuit on Jan. 23, and from the first it has been a decided success. Up to the present the following motors have been placed on the circuit and are running successfully: Windsor Hotel, elevator, 5 h. p., Excelsior; Floyd, Schock & Co., printers, 5 h. p., Excelsior; D. Clancy, sewing machines and fans, 1 h. p., Excelsior; Lestergett & Knight, fans, 1 h. p., Excelsior; Kingdon & Co., fans and orchestrion, 1 h. p., Excelsior; Starke & Callahan, fans, 1 h. p., Excelsior; A. D. Aldridge & Co., printers. 2 h. p., Card; F. G Ord, fans, ⅛ h. p., Card; Wm. Shea, fans, ⅛ h. p., Card; F. & G. Hamm, fans, ⅛ h. p., Card; Aug. Wood, fans, ⅛ h. p., Card; Turner & Co., fans, ⅛ h. p., Card; Emil Fritz, fans, ¼ h. p., Card; Dallas Club, fans, ¼ h. p., Card; C. H. Hewelle, fans, ¼ h. p., Card; W. J. Newman & Co., printers, ¼ h. p., Card; Sam Freshman, fans, ¼ h p., Card; Dr. Wilkins, dental lathe, ⅛ h. p., Detroit; Summerfield & Meredith, fans, ¼ h. p., Rhodes; Tom Cade, fans, ¼ h. p., Rhodes; Rowland & Sockwell, ¼ h. p., Rhodes; E. Duncan, printer, ¼ h. p., Baxter. This is a pretty fair showing for the motor interests.

Messrs. Clower & Harris report business as most excellent. In addition to the large number of motors sold by them in the past few months, they have just finished the contract at the Dallas City Hall, and the manner in which it was done speaks for itself. They had the entire contract for the electrical work, including annunciators, mayor's call, patrol calls and combination fixtures. Okonite wire was used solely throughout the building. Messrs. Partrick & Carter furnished the annunciators, etc., and Messrs. Bergmann & Co. the fixtures, a number of which were made after special designs. It is needless to say that the city is well pleased. Messrs. Clower & Harris also report an increasing demand for electrical house goods of all kinds, and are putting in large numbers of annunciators, bells, etc., while the demand for motors is far in excess of the supply, several orders having been refused owing to the inability of the motor manufacturers to fill the orders for several weeks. The incandescent plant recently erected by this firm at the Oak Cliff Theatre continues to give satisfaction. This plant was erected in 24 hours complete, with 120 lights. Everything, including engine, boiler, dynamo and material, had to be hauled three miles and set up; but by strenuous efforts it was accomplished, and the light turned on, to everybody's delight, showing what can be done when it is necessary.

The Texas State Fair and Dallas Exposition, to be held in October, promises to be the most successful of all. The attendance last year was all that could be desired and exceeded that of the previous years by several thousands; 300,000 people passed through the gates last year, and 500,000 are expected this year. Last year some efforts were put forth to have the electrical interests represented, but beyond the exhibit of Clower & Harris and the

lighting plant, nothing was done. This year the directors decided that in view of the rapidly growing interest in electricity by the public at large, special measures must be taken to have a large and attractive display of everything electrical, and to that effect a committee consisting of Mayor Connor, E. M. Reardon, cashier of the City National Bank, and James Moroney, of Moroney & Co. were appointed to attend to the matter. From the first the idea was to make this display a special feature of the fair and they wisely concluded that the Dallas Electrical Society, being the representative body of electricians in this vicinity, would best know what to do in the matter. As a result a special meeting of the society was held in their elegant new rooms on Tuesday evening, July 9, to confer with the fair association committee. Various measures were suggested, the Society pledging its assistance in the matter. In order to facilitate matters Messrs. J. M. Oram, D. M. Clower, Dr. Andruss, Wm. Enfield and H. M. Sutton were appointed a special committee. The committees named met on July 10 and decided to issue a circular letter to every manufacturer and dealer in electrical goods in the United States, setting forth the advantages to be derived from a display of this kind and asking their co-operation in the matter. The circular will be issued as soon as it leaves the printer's hands. The Association have generously decided to turn the entire affair over into the hands of the Society, feeling sure that it will be a success. The Society will assume direct charge of the display, and will have competent and trustworthy persons in charge to explain and point out the various articles. New and novel effects are being designed. The Association pays the entire expense and furnishes unlimited space and power. With such resources at hand, there can be nothing lacking to make it a grand success. Communications regarding the matter should be addressed to the Section of the Dallas Electrical Society. It is earnestly requested that those entered should give this matter their immediate attention, that the committees may know just what will be needed in the way of space, power, etc. The fair attracts visitors from all parts of the country, and it is needless to point out what can be gained by having the various electrical interests properly represented. The Society will establish its headquarters in the main building, and electrical men will find a cordial welcome. B.

ENGLISH NOTES.

(From our own Correspondent.)

London, June 26, 1889.

Telephone Amalgamation.—The telephone amalgamation scheme has given rise to what seems likely to be an interminable controversy between the postmaster-general and the companies, as to whether or not the present amalgamation scheme was contemplated by the two parties at the time the licenses were issued. The postmaster-general asserts that no such scheme as the present was ever contemplated by the department, and that if the amalgamation is proceeded with despite his warnings, something will happen. The companies say the exact opposite. Considering that long-distance telephony was not "in the region of practical politics" at the time the licenses were issued, and that every single license gave powers for the whole kingdom, it certainly seems reasonable to conclude that competition, not amalgamation, was what was contemplated. However, be that as it may, the fact remains that the post-office is opposed to amalgamation, though on what grounds is pure conjecture. The question which the shareholders of the three companies have, therefore, to do with is, what does this opposition amount to? What are the pains and penalties attached to running counter to the postmaster-general's wishes? Why the post-office objects and what it intends to do are questions for the general public to ascertain through Parliament. When this is ascertained it may perhaps be profitable to discuss the relative advantages of a government or private monopoly.

The Board of Trade Model Orders.—The "model orders" promised us by the Board of Trade some few weeks ago has now been issued, and in future all electric lighting companies applying for statutory powers over a metropolitan area will be expected to conform to its provisions. With one exception, and that a most important one, the model order differs very slightly from those already in existence. The important alteration to which I refer is the transfer *en bloc* to the London County Council by the Board of Trade of the important duties which have hitherto been assigned to itself or the existing local authorities, vestries, boards of works, etc. It is, of course, an advantage that the supply companies should be under one master rather than forty, but the "frankly democratic," not to say "socialistic," character of this new body, and the eagerness which it shows to undertake all and every duty, naturally makes the companies apprehensive of coming under its sway. The question of overhead wires is settled in three lines: "The undertakers shall not, without the express consent of the County Council, place any electric line above ground, along, over, or across any street." The powers of the electric inspectors, although extensive, have not been materially increased, and if the proper men are appointed their duties will doubtless be satisfactorily performed.

The Proposed Standardizing Laboratory.—The important question of the establishment of a government standardizing laboratory has now taken a decided step forward. On Wednesday last a joint deputation from the London Chamber of Commerce and the Institution of Electrical Engineers had an interview with the president of the Board of Trade, who gave a very satisfactory reply to their representations. A letter was read from Lord Crawford, who mentioned that the London Electric Supply Corporation would shortly require some 8,000 meters, all of which would have to be "certified" ones. Lord Rayleigh put the whole matter in a nutshell when he remarked that "electrical engineers were to issue certificated standards, and there was at present no means of obeying the law." Sir William Thomson then read the points which had been agreed upon to be submitted to the Board of Trade. The joint committee of the London Chamber of Commerce and the Institution of Electrical Engineers it seems have, after careful estimate, placed the cost of establishing such a laboratory, exclusive of building, at £4,000. Another highly important reason in favor of a standardizing laboratory was adduced by Mr. R. E. Crompton, who stated that English electrical instrument manufacturers were put to a disadvantage in competition with those on the other side of the channel, who were in a position to send their instruments for certification to Berlin and Paris, at which places standardizing laboratories had recently been established. Those instruments, when thus certified, had a higher commercial value in the market, and that fact alone ought to be some argument in favor of asking for this comparatively small sum of money. As I have remarked above, Sir Michael Hicks Beach replied in a satisfactory manner, although of course with the diplomatic avoidance of definite promise, usual to such utterances. Whatever step the Government may finally decide to take, there is no blinking two ugly facts namely, that as soon as the supply companies get to work a large number of meters and other instruments will require standardizing; that at the present moment no means exist of doing this work. It is to be hoped, however, that the 8,000 meters which Lord Crawford holds *in terrorem* over the Board of Trade will induce the authorities to come speedily to some decision. Considering that Government requirements have been the cause of the threatened *impasse*, it seems only right that Government should supply the means of overcoming it.

THE TELEGRAPH.

Naming a Paper.—According to Mr. Titus Merritt, the editor of the Spiritualistic organ, the *Celestial City*, that paper was named by the spirit of General Grant "through the medium of an occult telegraph instrument operated by the spirit of S. F. B. Morse himself."

War on the Poles.—The Board of Freeholders of Elizabeth, N. J., have declared war on all telegraph and telephone poles that interfere with the proposed improvement of the county roads. A resolution was passed by the Board directing the County Attorney to take steps to compel the companies to remove all poles on the line of the intended improvement, and if the mandate is not heeded the Board will have them cut down at the expense of the county.

THE TELEPHONE.

The Drawbaugh Telephone People are reported from Boston to intend making another effort, through the medium of the pending government suit.

Fort Worth, Tex.—The Erie Telephone Company has objected to the assessment of its franchise at $15,000, and has obtained an injunction preventing the city from levying on its property for taxes alleged to be due.

Justice but not Truth.—It is to be presumed that London *Justice* has made its computation with accuracy when it says that all the people now living in the world, or about 1,400,000,000, could find standing-room within the limits of a field ten miles square, and, by aid of a telephone, could be addressed by a single speaker —*New York Sun.*

The Minneapolis Convention.—General C. W. Barney, through his *News Letter*, informs intending delegates to the next meeting, which will be held at the West Hotel, Minneapolis, Minn., commencing Tuesday, Sept. 10, next, that they should secure their rooms by communicating direct with C. W. Shepherd, Esq., manager of the hotel. Exhibitors may also secure parlors for their exhibits in the same manner. The hotel is on the American plan, and the rates to delegates will be $3.00 and $3.50 per day, the latter price including room with bath.

THE ELECTRIC LIGHT.

The Marr Construction Company, of Pittsburgh, have secured the contract for the arc lighting system of the McKeesport Light Company, although it was reported that another concern had secured the order.

Fargo, Dak.—The gas and electric light interests in Fargo were consolidated recently, and improvements and enlargements are now being made in the electrical plant, which has been removed to new premises. The additions include engines, boilers, etc.

A Receiver Asked For.—Attorneys E. Potter Dustin and John J. McCarthy have filed a suit in the Common Pleas Court at Cincinnati against David J. Hauss, Jr., the Hauss Electric Light and Power Company, T. C. Campbell and Campbell & Bettman to collect a balance on a judgment for $205 against Hauss rendered by Squire McGrannahan. The petition alleges that Hauss has no personal or real property upon which to levy, and asks that the shares of the electric light company, of which he owns a large number, be subjected to the payment of the claim. A receiver is asked for to take charge of the stock.

Dissatisfied Taxpayers in Baltimore.—Judge Dennis, on July 15, granted an injunction asked by H. Irvine Keyser and others against the Mayor and City Council of Baltimore and the Brush Electric Light Company. The complainants number 100 taxpayers of Baltimore, and they asked an injunction to restrain the carrying out of the contract for lighting the city made with the Brush Company, and also to prohibit the payment of any money for such purpose. Messrs. Morrison, Munnikhysen and Bond were counsel for the complainants, City Solicitor Bernard Carter represented the city, and R. Stockett Matthews and R. W. Baldwin the Brush Company. The contract went into effect on the 1st instant, and it is claimed that the Brush Company has no claim upon the city for furnishing electric lights since that date, as notice was served upon them previous to July 1 that the contract would be contested. It is probable, however, that the case will be appealed.

New York City Bids.—At a meeting of the gas commission on July 18 the opinion of Corporation Counsel Clark was read relative to the protests presented at a previous meeting against the awarding of contracts to companies having no facilities or franchises to construct lines in localities covered by their bids. The opinion of Mr. Clark was that contracts should be awarded to the companies making the lowest bids, provided they had the requisite facilities for fulfilling such contracts. The commission decided to act in accordance with the opinion. Contracts were awarded to the Brush Company for 220 lights at 35 cents per light; to the East River Company for 24 lights at 35 cents each, and to the United States Company for 333 lights at prices ranging from 25 to 35 cents a night. The Mount Morris Company received a contract for 11 lights at 25 cents, and 18 lights at 24 cents. A contract which had been awarded to the Harlem Company was subsequently revoked, because the bid for lighting Harlem Bridge was higher than that of last year. The bid of the North New York Company was referred to the comptroller for investigation as to the propriety of paying the prices asked for, and the original bid of the Harlem Company was also referred.

APPLICATIONS OF POWER.

Houston, Tex.—The Houston Belt & Magnolia Park Railway Company will shortly begin work on their line, to be operated by electricity.

The British Museum is putting in a complete system of electrical alarms, and the Bank of England is adopting elevators run by electric motors.

Newburyport, Mass.—The Robinson-Foster Electric Company have a power circuit, equipped with their motors, running successfully in Newburyport.

The Brooklyn Heights Railway Company has been given permission to build an electric line on Montague street, from Court street to the Wall street ferry.

The Hannahs Railway Company has been formed to build and operate an elevated road by electricity, on the Hannahs system in Chicago. The incorporators are J. M. Hannahs, T. Rankin and D. V. Purington, and the capital stock is $2,000,000.

Auburn, N. Y.—The City Council has voted solidly for the Auburn & Owasco Lake Electric Railway, and it will be built. The Thomson-Houston system will be used.

The Quincy, Ill., Motor and Carrying Company has been formed by T. H. Osborne, J. H. Dukes and L. T. Dickason, with a capital stock of $100,000. It proposes to operate railways by electricity.

Portland, Ore.—It is stated that the Sprague system will be adopted for the Woodstock and Waverly Road in Portland. The road is to cost $75,000, and abutting property owners will give a bonus of $45,000.

Chattanooga, Tenn.—The Chattanooga Electric Street Railway Company has put its road into operation with satisfactory results, running from Broad street to Missionary Ridge, with six cars. Mr C. A. Lyerly is president of the road; Mr. E. Watkins, vice-president; Mr. S. W. Divine, secretary and treasurer, and Mr. W. H. Forbes, electrical engineer.

The Van Gestel Electric Street Car Company, of New York, has been formed, with a capital stock of $5,000,000. It will use Mr. J. T. Van Gestel's new type of storage battery motor. Mr. R. S. Dobbie is associated with the enterprise as electrical engineer. A factory has been secured, and the staff are already at work putting in the necessary machinery, etc.

Chattanooga, Tenn.—The Chattanooga Electric Street Railway has been built by Woodbridge & Turner, of this city, on the Sprague system. It is about six miles long and starts with eight cars, which on portions of the road are run at a speed of 12 to 15 miles an hour. The overhead system is used. The officers of the company are: C. A. Lyerly, president; E. Watkins, vice-president; S. W. Divine, secretary and general manager, and Mr. W. H. Forbes, electrical engineer.

PERSONALS.

Mr. Thomas A. Edison expects to leave for Europe on Aug. 3, and will be gone abroad for several weeks.

Mr. Francis R. Upton, the estimable vice-president of the Edison Lamp Company, was married to Miss Margaret Adriance Storm at Poughkeepsie, N. Y., on July 17. Mr. Upton expects to leave for Europe shortly.

Mr. I. Everson Winslow, who had charge of the construction of the Thomson-Houston electric road at Bangor, Me., has just completed the new Crescent Beach road, under the same system. It was desired to have the road running by July 4, and it was in full swing by that time, although the time available was but three weeks.

Mr. Max J. Becker, the president of the American Society of Civil Engineers, spoke highly in his recent annual address of electrical engineering. He described electricity as certainly destined to excel all other forces of Nature in the extended range of its useful application. He alluded to the rapid progress in electric railroading, and praised the operation of the Bentley-Knight road at Allegheny City, where he lives.

MISCELLANEOUS NOTES.

Electrical Engineering Apparatus for Princeton College.—Messrs. James W. Queen & Co., of Philadelphia, the well-known manufacturers and importers of electrical test instruments, report the sale of a bill of goods amounting to $4,000 to Princeton College for the equipment of their course in electrical engineering to be inaugurated in September next. The list embraces several of Queen's large Wheatstone bridge sets, as devised by Prof. Wm. A. Anthony, and pronounced by Prof. B. F. Thomas, of Ohio State University, to be "superior to Elliott's dial form." These sets, as well as several of the next size smaller, also ordered by Princeton College, are all guaranteed by Professor Anthony to be accurate within one-fiftieth of one per cent. There is also a large $375 reflecting galvanometer made for the special purpose of measuring high insulation resistance, the galvanometer itself having a resistance of 500,000 ohms. This will be the only instrument of the character in the United States. For measuring induction coefficients, etc., there is provided one of Ayrton and Perry's secohmmeters. For the determination of magnetic constants there is a large Weber earth inductor, which will be used in addition to the Kew magnetometer, already possessed by the physical department. There is also a Kohlrausch unifilar electro-dynamometer for the measurement of very weak currents, such as those used in telephone work, etc. This suspension has the minimum amount of torsion as the current is conveyed out of the instrument by means of a platinum strip attached to the movable coil and dipping into a dilute solution of sulphuric acid. A pair of Wiedemann's large dead-beat reflecting galvanometers, Sir William Thomson's astatic reflecting galvanometer, one of Elliott's differential galvanometers, as well as his ballistic instrument, a Wheatstone-Kirchoff cylinder bridge, Kohlrausch's mirror differential galvanometer, condensers, telescopes, etc., go to make up the remainder of as fine an outfit of electrical test apparatus as has ever been sold at any one time in this country.

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

The Roaring Fork Electric Light and Power Company of Aspen, Colo., say that Schieren's Perforated Electric Belts are giving them the *best* of satisfaction; they claim, that these belts run smoother, straighter, and with less slipping than any other belts which they have used. Chas. A. Schieren & Co., (manufacturers) New York, Boston, Philadelphia, Chicago.

Patterson, Gottfried & Hunter, 146-150 Centre street, 111-115 Walker street, carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rods, sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

American Ozokerite.—The company producing this material needs only a very moderate amount of additional capital to carry forward their production to a dividend paying quantity. Manufacturing electricians should all be interested. Profits are large, over producing cost and the deposits are inexhaustible. The subject has been largely treated of in former issues of this paper and also in the *Engineering and Mining Journal* and the press generally. A few moments given to investigating this matter will convince any one that a most profitable enterprise is wanting capital only.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED JULY 9, 1889.

406,415. Dynamo; William S. Andrews, of New York, N. Y., and Thomas Spencer, of Westbrook, Conn. Application filed Aug. 17, 1886. Stationary coils are provided, situated externally to the armature, and supported upon the field magnet poles, which coils are wound and connected so as to oppose the magnetizing effect on the armature core of the generating coils.

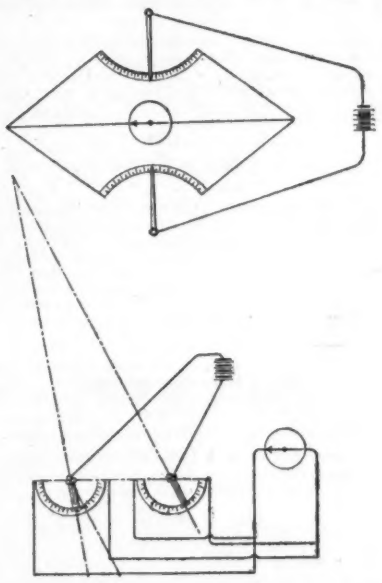
406,420. Electric Railway Switch; Francis O. Blackwell, of New York, N. Y. Application filed Nov. 23, 1888. Consists in a combination of fixed main branch conductors with a movable switch point which is out of circuit with the fixed conductors, but acts as a mechanical guide for the traveling current collector. It also consists in the combination of a switch point with an electrically propelled car provided with contacts which bridge the switch point, whereby when the car passes the switch the forward contact will pass over the switch and contact with the fixed conductor beyond before the rear contact reaches the switch.

406,423. Signaling Apparatus for Elevators; John F. Bower, of Chicago, Ill. Application filed Oct. 19, 1887. The combination, with an elevator car and its shaft, of a stationary located signal-trip device, as a trip-lever operated by the car when going down, a second stationarily located signal-trip device, as a trip-lever operated by the car when going up, and electric circuit embracing magnets for setting these trip devices, and buttons or switches placed at the elevator stations or landings.

406,429. Dynamo-Armature; Stanley C. C. Currie, of Philadelphia, Pa., Assignor to the United Electric Improvement Company, of Gloucester, N. J. Application filed Nov. 15, 1888. In a multipolar dynamo electric machine, the combination of a commutator whose bars are insulated from each other with an armature in which the winding or circuit between the two commutator-bars traverses or influences each pole thereof, is connected at each of its terminals with but a single point or bar in the commutator, and is unconnected at any intermediate point with any other commutator-bar.

406,439. Secondary Battery; William W. Griscom, of Haverford College, Pa., Assignor to the Electrical Accumulator Company, of New York. Application filed April 12, 1889. The supporting points or shoulders are formed out of and are part of the cell itself.

(1) 406,468; Electrical Switch. (2) 406,469. Connection Box; Joseph A. Powers, of Lansingburg, N. Y. Applications filed March, 23, 1889. (1) In an electric switch the combination, with an insulating contact carrying disc loosely mounted on a vertical spindle, detents for limiting the range of movement thereof, and rollers mounted in opposite sides of the disc, of a lever pivoted to the spindle and a circular spring carried thereby and bent to form a cam track with two prominent points adapted to engage with the rollers. (2) The combination with a base or



406,830. METHOD OF FINDING RANGE AND POSITION OF DISTANT OBJECTS.

block adapted to be placed over the wires of a circuit, of connecting plates for inclosing the wires and the safety strip.

406,489. Telegraph Key; Henry A. Waldo, of Reno, Nev. Application filed May 5, 1888. The combination, with a telegraphic key, of a self-closer consisting of a pair of pivotally mounted arms, having a stem overlying the key button and a pair of spring fingers adapted to contact with the sides of the arms of the self-closer.

(1) 406,492. Armature Winding for Dynamos. (2) 406,493. Self Regulating Dynamo. (3) 406,494. Regulator for Dynamo Electric Machines; James J. Wood, of Brooklyn, N. Y. Applications filed (1) Oct. 12, 1888. (2) Nov. 20, 1888. (3) Nov. 21, 1888. A gramme armature wound with juxtaposed pairs of coils consisting of a single length of wire with its middle portion crossing between the two coils, and an insulating sheath separating the two coils. (2) According to this invention one or both of the terminal brushes of a shunt field coil are mounted on a yoke independently of the main circuit brushes, which are fixed in position, and said yoke is connected through the medium of a suitable mechanical connection with the movable member of an electro-motive device so connected electrically to the main or external circuit as to be responsive to changes occurring therein of the character for which the dynamo is designed to compensate. (3) The invention provides a method of regulation differing from any heretofore applied. The field magnet is wound with two coils—the usual main magnetizing or exciting coil connected in a shunt. The inverse current through this shunt coil is a continuous current, which flows continuously during the normal running of the dynamo and is increased or decreased by the action of an automatic regulator responding to changes in the main or external circuit, and proportionately varying the electromotive force of the current in a shunt coil, so that it more or less reduces the magnetization of the field magnet, and thereby compensates for any increase or decrease of current due to variations of resistance in the current or to variations of speed of the dynamo.

406,498. Incandescent Lamp; Charles A. Backstrom, of New York, N. Y. Application filed March 26, 1889. In combination with a filament of an incandescent electric lamp, a rib fastened to the base of said lamp and abutting loosely between the sides of the seal thereof, said rib being provided with an aperture through which said filament is adapted to pass.

406,567. Telephone; Thomas A. Edison, of Menlo Park, N. J. Application filed Feb. 19, 1886. An electrode for telephones composed of a body of granules of carbonized hard coal.

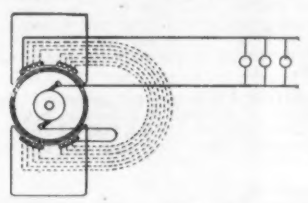
406,599. Dynamo Electric Machine; William L. Silvey, of Lima, O. Application filed April 20, 1888. Renewed April 13, 1889. An armature for dynamo-electric machines, consisting of two interlocking spiders on which are mounted end plates, one at each end, with numerous alternate blanks of sheet iron and paper pressed between them, and the whole mounted on a shaft.

406,600. Electric Railway Motor; Frank J. Sprague, of New York, N. Y., Assignor to the Sprague Electric Railway and Motor Company, of same place. Application filed June 4, 1889. The main object is to distribute the weight of the motor more evenly upon the driving axle, to prevent the motor from straining laterally, and to reduce the liability of the disabling of the apparatus by accident. The improvement mainly consists in dividing the bearings of the motor upon the axle into two parts, which are somewhat removed from each other on the axle.

406,629. Electric Horse Disconnector; George A. Coulter, of Omaha, Neb., Assignor of one-half to James C. Ish, of same place. Application filed Sept. 15, 1887. The invention is in the nature of an electrical apparatus for automatically releasing the horses from their stalls in the fire-engine house by the electric impulse on the fire-alarm circuit, whereby the horses may be geared to the engine with the least possible delay; and it consists in the peculiar construction and arrangement of the devices for locking and opening the stall doors and electrical devices for tripping and releasing the same.

406,636. Galvanic Battery; Matthew Dougans, of Worcester, Mass., Assignor of one-half to Edward P. King, of same place. Application filed March 14, 1889. The excitant paste for batteries, composed of madder, sal-ammoniac, sulphate of zinc, bichloride of mercury and water, mixed together.

406,656. Galvanic Battery; Friedrich Lotz, of New York, N. Y., Assignor by direct and mesne assignments, to John A. Amundson, of same place. Application filed Jan. 16, 1888. Renewed Dec. 14, 1888. The invention consists of an electric battery



406,415. DYNAMO.

the exterior walls and top of which are formed of hermetically sealed zinc plates of suitable thickness, which form one pole of the battery, the other pole being formed by a block of carbon at the interior of the casing, which carbon is supported in the casing by a screw post that is retained by insulating collars and fastening screw nuts at the top of the casing.

406,678. Recording Apparatus for Electric Meters; G. W. Walker, of
For description see page , this issue.

406,681. Lightning Rod; John Henry Charles Watts, of Baltimore, Md. Application filed April 12, 1889. A coupling for lightning rods, consisting of flat resiliant spring, interposed between screw-threaded shanks of two section or lengths.

406,709. Invisible Burglar Alarm Electric Mat; James W. Dawson, of St. Louis, Mo. Application filed April 19, 1889. This invention relates to a perforated pasteboard of papier-maché sectional electric alarm mat for insertion beneath the carpet of the room, the sections of which mat are connected by tin or other metal strips that form electric conductors, which have connections with a battery and with an alarm-bell to alarm the household.

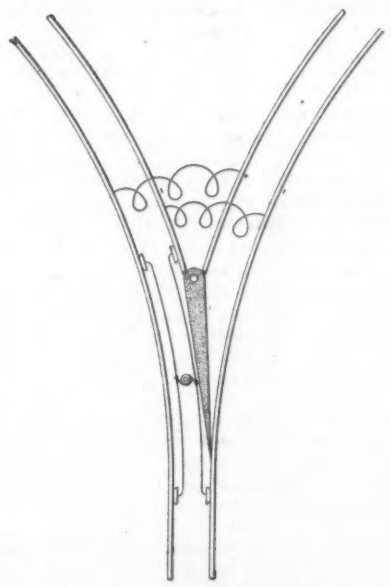
406,726. Galvanic Battery; Henry Groswith, of Philadelphia, Pa., Assignor of three-fourths to Charles W. Kennedy and Ransom F. Rankin, both of same place. Application filed April 16, 1889. Consists in the combination, with the battery, of an automatically operating feed or replenishing tank for supplying fresh liquor to the cells as the same is required, as well as maintaining the proper density of the liquor to keep the battery in proper working order.

406,751. Electrical Apparatus for Regulating Steam Boilers, etc.; Francois Martenot, of Paris, France. Application filed June 27, 1887. Patented in France, March 10, 1887; in Germany, July 4, 1887; in England, July 8, 1887, and in Belgium, July 22, 1887. Electrical devices for automatically feeding one boiler and opening relief valve.

406,771. Secondary Battery Electrode; Andrew L. Riker, of New York, N. Y. Application filed April 24, 1889. A secondary battery element consisting of a doubled or folded plate provided with tapering holes filled with active material, the smaller ends of said holes being outside, and a sheet of absorbent material interposed between said holes.

(1) 406,776. Laminated Core for Electrical Apparatus. (2) 406,777. Armature for Electric Machines; Albert Schmid, of Pittsburgh, Pa., Assignor to the Westinghouse Electric Company, of same place. Applications filed (1) Nov. 6, 1888; (2) Dec. 26, 1888. A core for electrical apparatus, consisting of thin stamped plates of magnetizable material placed side by side, and intervening layers or laminæ of electrically insulating magnetic oxide formed upon and covering the entire surface and edges of the plates. (2) An armature for electric machines, composed of laminæ of magnetizable material having openings, the openings through certain of said laminæ being of different shape from those of other of the laminæ.

(1) 406,797. Closed Slotted Conduit for Electric Railways. (2) 406,789. Mechanism for Controlling Electric Railway Motors; Charles J. Van Depoele, of Lynn, Mass. Applications filed (1) April 12, 1889. (2) April 13, 1889. The combination, with a conduit for electric conductors having a surface slot closed by flexible packing, of means for supplying compressed air to desired portions of the conduit and for confining the air therein. (2) A controlling mechanism for electric motors, comprising a pair of movable hand levers supported at either end of the vehicle to be propelled and at a distance from the motor or motors, two sets of movable mechanical connections, one attached to and operated



406,420. ELECTRIC RAILWAY SWITCH.

by each hand lever, current controlling devices mechanically connected to one of the movable connections for regulating the speed and power of the motor, and circuit-reversing mechanism connected and operated by the other of said hand levers and connections.

(1) 406,803. Carrier for Electric Railway Systems; (2) 406,804. Electric Railway; (3) 406,805. Electric Railway; David G. Weems, of Baltimore, Md., Assignor to the Electro-Automatic Transit Company, of same place. Applications filed (1) Jan 30, 1889; (2) Feb. 2, 1889; (3) March 7, 1889. (1) A car or carrier having closed semi-elliptical housings bolted to its external sides and adapted to contain the journal boxes for the shafts of the main bearing wheels. (2) In an electric railway system for passenger traffic, in which a train of cars is propelled, lighted, and heated by a current from an electric rail, a locomotive or carrier having a pointed end, the apex of which is provided with a signal light, both the head light and signal being in the main circuit and lighted thereby. (3) In electric railways, a main rail having a laterally extending flange, in combination with a conductor secured to the bottom of said flange, but insulated therefrom, and bolts passing through the flange, and securing the conductor in position.

406,806. Electric Railway; David G. Weems, of Baltimore, Md., Assignor to the Electro-Automatic Transit Company, of same place. Application filed March 15, 1889. In electric railways, a locomotive having a motor operated by the main current and a supplemental motor in the main-motor circuit for effecting a preliminary movement of the driving wheels on the locomotive.

406,809. Message and Time Recorder; John C. Wilson, of Boston, Mass. Application filed June 25, 1888. The combination, with a self-starting register, of a time stamp comprising continuously moving time-printing devices and a presser, the paper fed by the register and upon which the signal is recorded moving between the said time-printing devices and the presser, an electro-magnet controlling the presser for effecting the printing of the time on the paper, and a circuit-changing device controlled by the register for changing the condition of the circuit of the electro-magnet.

406,818. Underground Conduit for Electrical Conductor; George W. Cook, of Detroit, Mich., Assignor of one-third to Charles C. Canny, of same place. Application filed Dec. 8, 1888. A conduit for electrical conductors, consisting of a series of like paper tubes saturated with paraffine and taper jointed together.

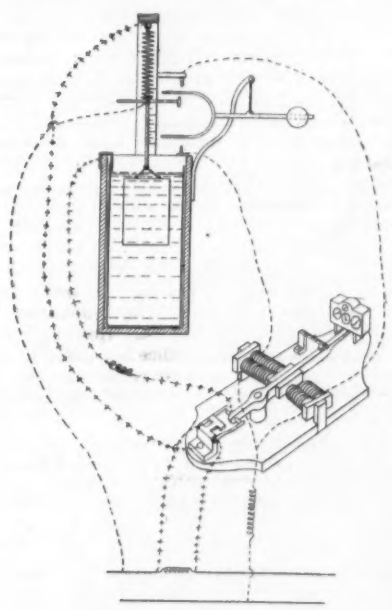
406,822. Secondary Battery; Harry E. Dey, of New York, N. Y., Assignor to Phœbus H. Alexander, of Hyde Park, Mass. Application filed Feb. 16, 1889. The combination, with an open box, or case, of a series of smaller vertically arranged battery plates of a width less than the interior of the case, insulating strips between the sides and lower ends of said plates, thereby forming cells between the plates, and an insulating and waterproof cement filling between the sides of the case and the edges of the plates.

406,824. Electric Meter; Thomas A. Edison, of Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York, N. Y. Application filed January 31, 1881. The combination, in an electric meter, of a cell, a spring suspended electrode therein, and means controlled thereby for registering the rise and fall of such electrode in the cell. See illustration.

406,825. Electric Meter; Thomas A. Edison, of Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York, N. Y. Application filed Sept. 13, 1882 The combination, with the electrodes of an electrolytic cell, of a rotating body forming part of the circuit between them and caused to revolve by the differences in weight between the two sides, due to the deposition and removal of metal.

406,829. Range Finder; Bradley A. Fiske, of the United States Navy. Application filed Oct. 17, 1888. The invention consists in a new apparatus for determining the angular changes in position of a body moving about a centre by measuring the electrical resistance of a conductor extending between the initial and final positions of the body. See illustration.

406,830. Method of Finding Range and Position of Distant Objects; Bradley Allan Fiske, of the United States



406,824. ELECTRIC METER.

Navy. Application filed Feb. 27, 1889. The invention consists in a new method of finding the range and position, which depends upon the determination of a fractional portion of a conducting body bearing in length a ratio to the angle included between two lines of sight directed upon said distant object, and the measurement of the electrical resistance of said length.

406,833. Means for Propelling Vehicles by Secondary Batteries; William W. Griscom, of Haverford College, Pa. Application filed March 20, 1889. The improvement consists in dividing the total number of cells of secondary battery into eight series and placing them into position in the plane of the wheels, two series of cells substantially equal in number being placed parallel in the plane of and adjacent to each wheel, thus distributing the weight equally over the four wheels of the car and dividing the battery into equal portable sections, which may be simultaneously and rapidly removed and replaced by eight gangs of men operating both from the inside and from the outside of the car.

406,858. Method of Forming Laminated Cores for Electrical Apparatus; Albert Schmid, of Allegheny, Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed May 13, 1889. The method of constructing the cores of electrical apparatus, which consists in first stamping out plates of magnetizable material, such as soft iron, afterwards annealing and coating them with an insulating oxide and building up the core from such annealed plates.

406,859. Method of Forming Cores for Electrical Apparatus; Albert Schmid, of Allegheny, Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed May 13, 1889. The hereinbefore-described method of constructing the laminated cores of electrical apparatus, which consists in building up the cores of plates or sheets of magnetizable material, turning the core to the proper shape and form, afterward separating the plates oxidizing the same, and finally reassembling the same.

406,906. Cut-Out for Electric Circuits; Warren S. Hill, of Boston, Mass. Application filed May 4, 1888. In an electric cut-out, the combination, with the main and working circuit terminals, of two pivoted frames, each carrying connecting conductors, a lever for operating both of the frames, a segment on the lever, and projections on the frames arranged in the path of the segment, the segment being wider than the space between the projections, whereby the connection between one set of the terminals must be completed before the connection between the other set is broken.

406,916. Secondary Battery; Isidor Kitsee, of Cincinnati, O., Assignor to Mayer Sulzberger, Trustee, of Philadelphia, Pa. Application filed May 10, 1888. An electrode for a secondary battery, consisting of a supporting plate formed of a porous material and provided upon one or more of its surfaces with a layer of suitable element substance.

406,917. Electric Track Sweeper; Walter H. Knight, of New York, N. Y. Application filed March 5, 1889. The combination, with an electrically propelled vehicle, of a track sweeper connected thereto, consisting of a rotating broom or cleaning device, with an independent operating motor supplied from the same source as the propelling motor of the vehicle.

406,922. Electric Motor; George W. Mansfield, of Cleveland, O., Assignor to Matthew H. Robinson and Orlando A. Foster, of Boston, Mass. Application filed Feb. 27, 1889. An electric motor or magneto-electric machine consisting of a magnet having polar extensions between which the armature is arranged, with the part of said polar extensions near the magnet and neutral point fashioned into feet to support the motor, and the horizontal coil mounted between the polar extensions and attached thereto near the feet.

406,961. Regulating Device for Electric Railway Cars; William M. Schlesinger, of Philadelphia, Pa. Application filed Nov. 6, 1886. The object of the device is, broadly, to furnish means whereby unskilled operators, such as ordinary car drivers, may be enabled to run electric railway cars without danger of mistake. To this end all the electrical operations necessary in running such cars are controlled by the movements of a single lever. This lever is so connected electrically with the motor circuit and with circuit controllers therein, that a movement thereof in one direction will cause the motor to propel the car forward, a movement in the opposite direction and to a certain distance will reverse the action of the motor, and a movement to a certain fixed point will break the motor circuit and automatically apply an electric break, while the speed of the motor is dependent upon the distance to which the lever is moved in either direction. Thus by simple movements of a single lever a driver can control without difficulty the movements of an electric car.

PATENTS ISSUED JULY 16, 1889.

11,012. Reissue. Magnetic Separator; Gurdon Conkling, of Glen Falls, N. Y. Original No. 382,863, dated June 5, 1888. Application filed June 3, 1889. The combination with the primary apron of a secondary apron, to operate transversely to the primary apron, a magnetized plate secured in proximity to said secondary apron so as to draw the iron particles to said secondary aprons, and suitable driving mechanism for actuating the aprons.

406,874. Electric Motor; John Buckley, of Boston, Mass. Application filed June 13, 1888. In an electric motor, two armatures, each consisting of a pair of spools or bobbins, each pair being secured to a separate bar, said bars being insulated from each other and mounted on a shaft to appear as one armature of four spools, the cores of which lie parallel to the shaft on which they are mounted in combination with a field magnet and two commutators.

406,890. Electric Heating Apparatus for Railway Systems. Application filed April 16, 1889. The heating apparatus is controlled independently of the motor for propelling the car and the condition of the circuit through said motor.

406,897. Electric Switch; Thomas F. Gaynor, of Louisville, Ky., Assignor to the Gaynor Electric Company, of same place. Application filed Jan. 23, 1888. In an electric switch, an insulating base, in combination with two line-plates, a ground-plate, and a pivoted contact lever having a spring tension contact upon the plate and provided with a stop projection, the plates having registering stop holes for the stop projection of the lever to enter into, the base or plates having characters which designate the nature of the connection made when the index of the lever is brought into registering position therewith.

406,968. Dynamo Electric Machine; Nikola Tesla, of New York, N. Y., Assignor of two-thirds to Charles F. Peck, of Englewood, N. J., and Alfred S. Brown, of New York, N. Y. Application filed March 23, 1889. An electrical generator consisting of the combination, with two rotary conductors mounted in unipolar fields, of a flexible conductor or belt passing around the peripheries of said conductors. See illustration.

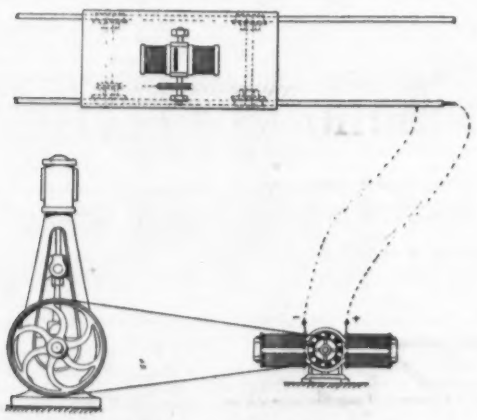
406,969. Secondary Battery; Charles H. Thompson, of Detroit, Mich., Assignor to the Woodward Electrical Company, of same place. Application filed Jan. 7, 1889. The invention consists in producing a support for an electrode, eventually to be formed and set up as an electrode for a secondary battery, which consists in first making a portion of a suitable metallic substance with a solid projection for a terminal, then producing the rest of the metal in a highly porous or cellular body by running the metallic substance among a refractory mass, afterward to be removed, the entire metallic substance, with the terminal, being made integral. See illustration.

406,975. Motive Apparatus and Time-Indicator for Use with Secondary Batteries; Jean Theodore Van Gestel, of New York, N. Y. Application filed Sept. 15, 1888. The combination of an electrical motor, a clutch for connecting the armature shaft of said motor to mechanism to be driven, mechanism connected to said clutch for operating it, a generator of electricity, and electrical connection operatively attached to the clutch controlling mechanism for connecting and disconnecting said generator to and from the motor at the same time that the armature is connected to or disconnected from the mechanism to be driven.

406,978. Underground Conduit; Thomas Wallace, of New York, N. Y., Assignor to the New York Atmospheric Conduit Electric Light and Power Company, of West Virginia. Application filed Jan. 25, 1889. The combination, with a conduit, of insulating guide rollers to support the conductors.

406,981. Automatic Cut-off for Secondary Batteries; Arthur Amory and Robert Amory, of Boston, Mass. Application filed March 19, 1887. An automatic cut-off for storage batteries, consisting of a tight casing or box, inclosing a battery or cell thereof to prevent the escape of pressure accumulating therein, a chamber, a pipe connecting said casing or box with said chamber, and containing a power transmitting medium, a piston or plunger in said chamber, and a switch connected with said piston or plunger.

406,982. Automatic Telegraph; Frank Anderson, of Peekskill, N. Y. Application filed Sept. 22, 1888. In an automatic telegraph, the following combination of elements: A single transmitting battery at a transmitting station connected to earth and directly to a main line, which it normally charges, a shunt around



407,188. Electric Railway.

said battery, including in its circuit an automatic transmitter adapted to open and close said shunt, a recording receiver at the distant receiving station located in the main line, and a condenser also located directly in the main line between the receiver and the earth,

406,994. Electric Wiring; Frank R. Chinnock, of Brooklyn, N. Y. Application filed March 30, 1889. The combination, with a cleat or back piece, of an insulator fitting within the same, and, provided with a flange behind it interlocking with the back piece.

406,997. Galvanic Battery, Patrick B. Delany, of New York N. Y. Application filed May 9, 1889. For description see page 49 of this issue.

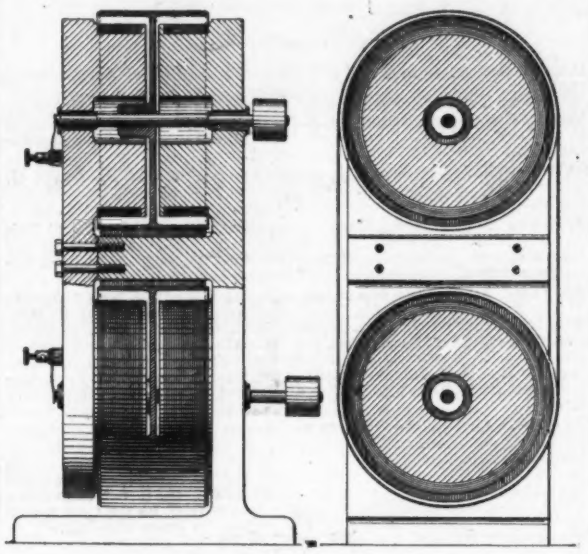
407,004. Telephonic Apparatus; Nathan S. Fisk, of Utica, New York. Application filed April 15, 1889. In a telephonic apparatus the combination of a projecting arm, a receiver supporter pivoted upon the arm, and the pivoted disc operated by the turning of the receiver upon its pivot and the contacting conductor springs.

407,014. Regulator for Electric Motors; John F. Kelly, of New York, N. Y., and Paul H. Brangs, of Newark, N. J., Assignors to the United States Electric Lighting Company, of New York, N. Y. Application filed July 31, 1888. In a regulating mechanism for electro-magnetic motors, the combination, with a driven shaft formed or provided with two eccentrics or cranks of unequal throw of two oppositely acting pawls or pushes oscillated by the cranks, wheels for shifting the position of a rheostat arm when moved by one or the other of the pawls, and a governor operated by the motor for controlling the action of the pawls.

407,077. Electric Cut-Out; James L. Kimball and Herbert C. Wirt, of Boston, Mass. Application filed March 28, 1889. In an electric cut-out, the combination, with a base provided with contact arms secured thereto and to which the line wires may be connected, of a cap or rosette provided with contact arms extended beyond the said cap or rosette and means to secure positive electrical connection between the contact arms of the cap and base outside of the cap.

(1) 407,086. Power Transmitting Connection for Vehicles; (2) 407,093. Method of Vehicle Propulsion by Electric Motors; (3) 407,094. Car Propelling Apparatus; (4) 407,095. Method of Vehicle Propulsion; Wm. Main, of Brooklyn, N. Y. Applications filed (1) Oct. 28, 1887, (2) and (3) Aug. 21, 1888, (4) May 15, 1889. In the propulsion of vehicles and the like by electric motors actuated by batteries, the method of changing the speed of the vehicle while causing the least possible deterioration of the battery, which consists in maintaining the flow of the current from the battery and maintaining, as nearly as practicable, a constant rate of revolution for the motor, and varying the ratio of transmission between the motor shaft and the driving shaft to correspond to the speed desired.

407,101. Signaling Apparatus; George F. Milliken, of Boston, Mass., Assignor of one half to Albert P. Sawyer, of Newburyport, Mass. Application filed April 1, 1889. The combination of an electrical annunciator for an elevator car, having indicators for



406,968. Dynamo Electric Machine.

announcing the different floors and words or symbols indicating direction, with transmitting keys attached to different floors, and electrically connected to said annunciator, each floor-indicator and direction-indicator of the annunciator being each electrically connected with its corresponding keys.

(1) 407,115. Electric Brush; (2) 407,116. Electro Therapeutic Device; Harry P. Pratt, of Chicago, Ill. Applications filed (1) March 21, 1889, and (2) March 7, 1889. In an electro therapeutic device, the combination of a chamber having its ends formed of conducting material, a cap of conducting material covering one of said ends, and an electric generator in the chamber having its poles in electrical connection with the said ends, whereby, when the device is held at one end in the hand and the cap on the other end is applied to the body, the circuit will be closed through the body.

407,154. Electrical Machine; Edwin H. Bennett, Jr., of Bayonne, N. J. Application filed Feb. 23, 1889. In an electric machine, an inner and outer armature confined within, and secured to, a frame fast to, and revolving with, said shaft, in combination with field magnets having pole pieces projecting between armature.

407,188. Electric Railway; Stephen D. Field, of New York N. Y., Assignor to David Dudley Field, trustee, and Stephen J. Field, Cyrus W. Field, Henry M. Field and Stephen D. Field. Application filed March 10, 1890. The combination of a stationary dynamo electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle movable upon or along said insulated section of track, an electro-magnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit controlling device placed upon said vehicle. See illustration.

407,204. System of Electrical Distribution; Daniel Higham, of Philadelphia, Pa., Assignor to the Higham Patent Right Company, of Rockland, Me. The combination, with the constant current mains, of one or more local stations, each containing a motor in series in the said mains, a separate dynamo driven from the motor, and incandescent lamps or other translating devices in series in the local dynamo circuit.

407,210. Lighting System; Joseph H. Hunter, of Pittsburgh, Pa. Application filed May 11, 1889. The combination of an electrical generator of alternating currents, a lamp circuit, and an alarm or signal having a magnet or magnets connected in parallel with the lamp circuit, and having a vibratory armature.

407,225. Commutator Brush and Holder; Osborn P. Loomis, of Somerville, Mass., Assignor to the Loomis Electric Manufacturing Co., of New York. Application filed February 23, 1889. The principal objects of the invention are to so improve the commutator brush, the brush-holder and its mountings and immediate connections that the strips or laminæ of the brush may possess greater elasticity, and yet be stout enough to resist bending or buckling up; that the brush may bear upon the commutator cylinder with a yielding spring pressure, so as to be held in close engagement therewith; that the machinery may be reversed without necessitating readjustment of the brushes, and that good electric connection between the commutator and the terminals may be obtained.

407,272. Electric Motor; Leonidas G. Woolley, of Grand Rapids, Mich. Application filed May 28, 1889. In an electric motor, the field magnet having its core constructed wider than the pole pieces, whereby the centres of the armature and the core may be brought closer together and the distance through which the magnetic lines must travel are thus reduced, while the proper quantity of metal in the core is maintained.

407,293. Regulation of Electric Motors; Daniel Higham, of Philadelphia, Pa., Assignor to the Higham Electric Motor Company, of same place. Application filed Oct. 3, 1887. Renewed Dec. 22, 1888. The combination of the armature of an electric motor and a field magnet having all its coils in series with the armature coils with a centrifugal governor driven by the armature shaft and electro-magnetic devices controlled by the governor to increase the field magnetism when the load is increased, and vice versa.

407,294. Method of Electrical Distribution by Secondary Generators; Rankin Kennedy, of Glasgow, County of Lanark, Scotland, Assignor, by mesne assignments, to the Westinghouse Electric Co., of Pittsburgh, Pa. Application filed Nov. 13, 1888. For description see page 55 of this issue.

PATENTS EXPIRED JULY 16, 1889.

128,945. Improvement in Electric Fuses; Charles A. Browne and Isaac S. Browne, of Adams, Mass. An electric fuse having the cup which contains the ordinary fulminating powders placed within that portion of the fuse head which contains the priming material.

129,000. Improvement in Electro-Magnetic Motors; José S. Camacho, of Habana, Island of Cuba. The electro-magnets composed of graduated cylinders with a coil around each.

129,085. Improvement in Commutators for Electro-Magnetic Machines; Victor Barjon, of New York, N. Y. A commutator for an electro-magnetic engine, composed of a conducting ring with V-shaped spurs, the spaces between which are occupied by non-conducting filling pieces.

129,124. Improvement in Apparatus for Electro-plating Iron with Copper, etc.; Arthur L. Freeman, of South Boston, Mass. A solution bath fitted with a perforated false bottom, sieve or strainer, whereby sediment is collected in the bottom of said bath below the strainer.

129,148. Improvement in Galvanic Batteries; Carl A. Linke, of Pittsburgh, Pa., Assignor to himself, Traugott Frenzel and Henry W. Oliver, Jr., of same place. Introducing a jet or jets of steam into the cup or cell of a galvanic battery.

129,207. Improvement in Bronzing Columns, Pillars, Monuments, etc. The process of bronzing all large iron goods, like pillars, columns, statues, etc., by electrode position, and to increase thereby their beauty and durability.

129,219. Improvement in Telegraph Apparatus; Theodore M. Foote and Charles A. Randall, of New York, N. Y., Assignors to the Commercial Printing Telegraph Company. A two-spool electro-magnet having its yoke or back piece in two pieces, and a type wheel having a letter or letters to express the denominator of a fraction.

129,331. Improvement in Combined Stereotype and Telegraphing Machines; Merritt Gally, of Rochester, N. Y. A series of die strips or connections having dies of varying widths thereon; they are flexible and are arranged side by side in a plane, for the purpose of permitting the dies to be turned out of their direct course, when required, and sit closely together in the line without throwing the dies "off their feet" or twisting or kinking the strips.

129,391. Improvement in Printing Telegraphs; John S. Brown, of Washington, D. C. A printing telegraph instrument, in which the unison stop is released by simply resuming the alternate action of the two magnets that turn the type wheel.

129,408. Improvement in Electric Signaling Apparatus for Railroads; Stephen C. Hendrickson, of Brooklyn, E. D., N. Y., and Frank L. Pope, of Elizabeth, N. J. The combination with an electric signaling apparatus, of a revolving electro-motor for operating the hammer of an alarm bell.

129,425. Improvement in Electric Signaling Apparatus for Railroads; Frank L. Pope, of Elizabeth, N. J., Assignor to himself, Stephen C. Hendrickson, of Brooklyn, N. Y., and James N. Ashley and James D. Lincoln, of Greenville, N. J. The arrangement of the ends of two abutting rails of a railroad track on separate chairs or supports upon a sleeper, whereby metallic contact between the rails is prevented and the extent of an electrical circuit limited.

129,465. Improvement in Battery Insulators; Augustus G. Davis, of Baltimore, Md. A battery insulator provided with a central longitudinal aperture.

129,526. Improvement in Signal Apparatus for District Telegraphs; Edward A. Calahan, of Brooklyn, Assignor to the American District Telegraph Company, of New York, N. Y. A finger key and stop in combination with circuit breaking wheels and their springs.

129,561. Improvement in Electro-Magnetic Vapor Baths; John A. Hoffman, of Mendota, Ill. An electro-magnetic vapor bath combining in its construction a box battery, the wires from which are connected to a reverser, and circuit wires, so that currents may be sent through the whole or only portions of the body, and in either direction.

PATENTS EXPIRED JULY 23, 1889.

129,641. Improvement in Printing Telegraph Apparatus; George L. Anders, of Boston, Assignor to E. B. Welch, of Cambridge, Mass. A printing telegraph instrument, having an electro-magnet, the vibrating distance of whose armature is controlled by the polarity of a current transmitted through an electro-magnet in such a manner that in the shorter vibrating distance of the armature it shall effect the release of the escapement wheel, and in its greater action shall secure an impression of a letter on a strip of paper.

129,675. Improvement in Lightning Rods; David Munson, of Indianapolis, Ind. A lightning rod composed of a plurality of angular wires, each separate wire being twisted around its own axis, and a number of such twisted wires formed into a rope, and a number of such ropes twisted around each other.

129,676. Improvement in Lightning Rods; David Munson, of Indianapolis, Ind. A lightning rod consisting of a plurality of angular copper wire ropes, combined with and laid around an iron core.

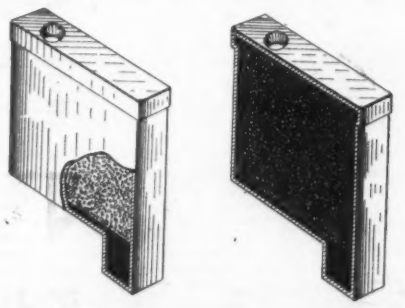
129,677. Improvement in Lightning Rods; David Munson, of Indianapolis, Ind. A lightning rod constructed of two or more separate and distinct ropes, each consisting of a plurality of angular copper wires, twisted each separately around its own axis, and then laid or twisted to form a rope, in combination with a like number of iron core rods, both intertwisted with each other.

129,683. Improvement in Lightning Rods; James Robertson, of New York, N. Y. A three-flanged rod and a sheet metal slotted coupling fitted to the notched ends of the joints to be coupled.

129,725. Improvement in Combined Stereotyping and Telegraphing Machines; Merritt Gally, of Rochester, New York. A stereotype blank, a part of the face of which is removed, so that the compression in forming one part of the stereotype will not displace the parts previously formed, or other parts of the face not compressed.

129,752. Improvement in Electro-Magnetic Apparatus; Rudolf Sayer, of New York, N. Y. A vibrating hammer graduated and combined with a frame vertically adjustable to any one of the steps of said hammer.

129,839. Improvement in Automatic Telegraph Transmitters; George Little, of Rutherford Park, N. J. Me-



406,969. Secondary Battery.

chanism for closing and breaking a circuit to the main line at two points by the perforated paper simultaneously.

129,840. Improvement in Automatic Telegraph Receivers and Transmitters; George Little, of Rutherford Park, N. J. A roller or drum made of two parts, insulated from each other, in combination with separate metallic connections from the respective parts of said drum.

129,857. Improvement in Electro Magnetic Engines; William H. Odell, of Yonkers, N. Y. The invention consists of a yoke arranged between, or at right angles with, the cores of the helices or magnets, and carrying armatures on its exterior to produce a direct reciprocating motion between the magnets, said yoke serving as a means to communicate power from the motor

129,858. Improvement in Insulating Telegraph Wires; Joseph Olmstead of Providence, R. I. The method of filling the pores of the covering by dipping in paraffine or wax, and subsequently compressing the same.

129,867. Improvement in Electrical Pole-Changers; John E. Smith, of New York, N. Y. In a pole-changer operating by distinct rubbing and direct pressure electrical connections, the construction of the rubbing electrical connections in part of a non-conductor.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.